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The Economics of Initial Public Offerings (IPOs): Empirical Evidence from the Biotech Industry

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INTRODUCTION

The theory of Initial Public Offerings (IPOs) has always fascinated economists, investors and simple readers. Starting during the 60s, different authors dealt with IPOs, trying to explain the economic content of this matter and all the problems it carried. As the decades passed, the subject of IPOs have become one of the most relevant in the matter of corporate finance.

This thesis has the exact purpose of revealing part of this huge and complex argument by scratching the surface of it, giving the reader an idea of what an IPO is, why is it so actual today, what problems does it carry, and many others.

The event that fuelled the creation of this paper was the advance of IPOs in the biotech market of the last years. This fascinating fact incouraged the analysis not just of the specific happenings in this sector, but also the general subject of IPOs, with its economic reasoning and rationale.

In 2013 39 U.S biotechnology companies have gone public raising more than $3.3 billion dollars in the public market. The healthcare IPO market has also outperformed other IPO sectors during that year with an average total return of almost 70%.

How can this fact be explained, considering that this boost in the biotech sector hasn’t happened since the dot-com bubble?

Biotechnology has always been viewed as a risky market, characterised by uncertain returns. However, steady gains by the NASDAQ Biotech Index (NBI) has boosted investor confidence in this sector.

Moreover, the Food and Drug Administration (FDA) has adapted, becoming more responsive towards drug developers, implementing faster drug approval processes. Both the strong performance and the favourable regulatory processed has made biotech companies more independent from the large pharma, who in the past would acquire or license products at the early development phases, covering most of the burdening costs.

This surge of the Biotech IPO industry hides some risks and dangers. Immature companies may rush into the public market searching for funds, but performing badly, shaking investor confidence and discouraging future investments. If this event happened, the whole bubble could explode, leading both healthy and unhealthy firms to suffer extensive losses.

However this biotech market is different from other periods characterised by good performance, and this is mainly due to the financial maturity that the biotech bubble of 2000 has created. Investors are more critical when analysing investment opportunities, and the financial crisis of 2008 has strongly increased awareness and selectivity.

Another driver of the biotech market growth is the greater insight scientists have to factors causing diseases: while in the first years of the millennium biotechnology was focused on discovering molecules with unknown catalytic characteristics, today the deeper understanding of the DNA structure and all its branches have led therapeutic treatments to be more intelligent and sophisticated.

When looking at the future, it will become imperative for investors to distinguish between superior companies and inferior ones by selecting with judgement, trying to sustain a market which hasn’t revealed its true nature yet.

But before analysing this market from an econometric point of view, it is necessary to have a major and better idea of what constitutes an IPO and what it really is.

The first chapter will take in consideration the IPO from a corporate standpoint, describing its characteristics and the process which leads a firm from being private to public. Some words about the secondary offerings (those following the IPO) will also

be spent, since the SEOs are often for the companies the true driver which leads them to the public market.

In the second chapter the focus will be set upon three different phenomena which have characterised past literature about the IPO process: stock underpricing, the "hot" issue market and the long-term underperformance. These problems are still actual today, and while on some of these issues economists have tried (more or less successfully) to explain them, on others we still have no perfect answer.

The IPO literature will then be reviewed and discussed, from the first famous papers of Ibbotson in the 70s, to more recent ones of the 90s and 00s.

The third and last chapter will have the biotech market as background. Infact, it will be conducted an econometric analysis of a sample of biotech companies who performed and IPO in the last years, with the help of different variables ranging from financial ratios to strategic and operative ones. The aim is to more comprehensively understand this market, trying to see whether there is a pattern among the companies going public, some characteristics which lead them to an IPO (is it something related to their financial standing or maybe to more operative elements?).

As the reader will know, no econometric analysis will lead to a conclusive and certain answer, but the aim of creating an insight towards the problem may be considered accomplished.

CHAPTER 1

The Functioning of an IPO

The IPO or Initial Public Offering is a type of public offering where shares in a company are sold to the general public for the first time. Firms may receive funds in different ways, not just through selling equity stock to the open public, but also through angel investors, venture capital firms, private equity firms or simply through debt. This chapter will focus specifically on IPOs and their mechanism. The procedure through which companies go public is complex and has been matter of financial discussion throughout the years, which led institutions to adopt changes to the way is carried out.

When private companies search for outside equity capital (of course debt is one funding option, but the focus here will be on equity), it may seek funds from different sources: angel investors, venture capital firms, private equity firms or corporate and institutional investors.

Angel investors are individuals who purchase equity in small private firms. Very often angel investors are friends or acquaintances of the firm's management. Due to the fact that their capital contribution is usually large, they receive equity share in the business in return for the funds. As a consequence, these investors have a strong influence in the firm's business decisions (it may happen that angel investors contribute with their expertise to the company's operations).

Venture capital firms are limited partnerships which specialize in raising capital to invest in the private equity of small young firms. Generally the limited partners are institutional investors while the general partners, the venture capitalists, run the venture capital firm. Venture firms invest in many start-ups, so to diversify risk in favour of the limited partners. Moreover, these may enjoy the expertise brought by the general partners. As a

reward, general partners will receive an annual management fee (from 1,5% - 2,5% of the fund's committed capital) plus a share of returns generated by the fund.

Private equity firms are similar to venture capital firms, but they invest in equity of already established privately held firms rather than start-ups. Often private equity firms adopt a transaction known as leveraged buyout (LBO) in order to purchase the outstanding equity.

Institutional and corporate investors may be respectively pension funds, insurance companies and established corporations who purchase equity in younger firms (they might do it as a corporate strategic objective).

1.1 IPO Procedure

The process of selling stocks to the general public for the first time is called initial public offering (IPO). There are both advantages and disadvantages in going public (as can be seen in Table 1). An IPO gives the chance to a company to access a wide pool of investors who can provide capital for future growth or debt repayments. For early investors who choose to sell their shares as part of the IPO process, this represent a possibility to monetize their investments. During the IPO the company is listed on a public exchange and the money paid by investors for the new shares flow directly to the company. The table below lists both advantages and disadvantages of going public. It is important to understand that the IPO process is time consuming, complex and requires the company going public to have a clear picture of its core business characteristics before opting for this solution.

Table 1 – Advantages and Disadvantages for a firm going public

Advantages	Disadvantages
Enlarging and diversifying the equity base	Substantial legal, accounting, marketing costs
Enabling cheap access to capital	Requirement from institutions to disclose financial and business information
Improving exposure and public image	Great effort and time required by management
Attracting / retaining better employees or management through liquid equity participation	Public disclosure of information useful to competitors or customers
Facilitates acquisitions offering shares in return	Loss of control and strong agency problems due to new shareholders

After deciding to go public through an IPO, the managers of the issuing company work together with an underwriter, an investment bank who is responsible for the management and design of the offering. There are different offerings which can be carried out by the company: a primary offering is the first issuance of stock for public sale by a private company; a secondary offering generally follows a primary one, and serves as a way for a public company to raise further equity capital for its business.

IPOs often involve more than one investment bank (underwriters). The issuer enters a contract with the lead underwriter to sell its shares to investors and then the underwriter directly approaches the investors with offers of sale of those shares. When IPOs involve large sums of money, they are usually underwritten by a "syndicate" of investment banks with the election of a lead underwriter. When selling stocks, the underwriters gain a portion of the proceeds as fee (underwriting spread). This is calculated as a discount from the price of the shares sold. Inclusive in the underwriting spread are both manager's fee

and underwriting fee. The managing underwriter is known as the bookrunner and typically sells the greatest amount of shares of the IPO and takes the greatest portion of the gross spread (typically ranging 6-8%).

There are four different ways to sell shares in an IPO (four contracts are generally used):

- In the best efforts contract the underwriter doesn't guarantee that all the stock will be sold but tries to sell as many shares as possible at the agreed-upon price
- In the firm commitment contract the underwriter guarantees the sale of the issued stock at the offer price. The underwriter purchases the entire issue and resells it at the agree-upon price (if the entire issue is not sold out, the underwriter must take a loss)
- Under the all-or-none contract, the underwriter agrees to sell the entire contract or otherwise the deal is cancelled
- A bought deal occurs when the underwriter buys securities from the issuer before the preliminary prospectus is filed. The investment bank (or underwriter) takes the position of principal rather than agent therefore goes "long" in the security (the issuing firm won't bear any financing risk)

The issuer usually allows the underwriters (in order to reduce the risk taken by them) an option to increase the size of the offering up to a maximum of 15%. This is known as the greenshoe option. It can be exercised within 30 days of the offering and doesn't have to be exercised the same day. The underwriter will choose the overallotment option when demand for shares is high and these are trading above the offering price. This allows the issuing firm to raise additional capital. The purpose is often that of stabilizing the price of the shares, avoiding their decrease below the agreed-upon price: if the stock drops below the offering price, the underwriters buy back some shares paying less, therefore decreasing the supply and increasing the price; if the stock rises above the offering price, the greenshoe option allows the underwriters to purchase back the excess stocks at the offering price (therefore no money will be lost).

During this “origination phase”, the investment bankers must understand whether the firm is ready for the IPO. So the firm’s historical financial performance is analysed and taken in consideration. The firm’s management must, however, obtain a series of approvals for the IPO to be carried out. The firm’s BOD (board of directors) has to approve the sale of securities and the shareholder’s approval is required too (if the shares will increase). Securities sold must then meet some requirements (laid down by the European Union’s directive on financial instruments). In the EU a two-level system operates: larger companies need to comply to this directive while smaller issues are subject to national rules and standards.

The first step is to file the preliminary prospectus. This is known often as red herring prospectus due to the red warning statement printed on its cover (the offering information is not complete and may be subject to changes). During the quiet period, shares may not be offered for sale. In the US, the SEC requires the preparation of the registration statement which provides financial information of the company to investors prior to the IPO. The sec reviews the statement to be sure of the compliance to all requirements and then approves the stock for sale to the public. The firm then prepares the final registration statement together with the final prospectus which contains all detailed information about the IPO: the number of shares offered, the price, and many others. The registration statement is printed on Form S-1.

1.2 IPO Pricing

The pricing mechanism of the IPO typically involves a lead manager (bookrunner) and may happen in two different ways: either the company, together with the lead managers, fixes a price (this is known as “fixed price method”), or the price is determined through a thorough analysis of information obtained confidentially by investors through a process known as “book building”.

During the book building process, the “book” represents all indications of investor demand. This practice is very common in developed countries and also in emerging

markets. The price at which the newly issued shares are offered is determined after the book is closed at the discretion of the bookrunner (managing underwriter) and issuer. Bidding in the book is by invitation only so it is not opened to the public investors. The issuer and the bookrunner may grant some bidders a greater allocation of their bids than other investors. In general, large institutions who bid receive preference over small retail bidders and receive greater allocations of stocks. In the book building process bids are confidential, by invitation only, all shares are transferred at the same price and both the bookrunner and the issuer determine the price of shares. The bookrunner collects the bids and these can be revised by the bidder before the closure of the book. The final issuing price is decided upon this close.

In general the book building system helps the issuing firm to determine the value of the security. Infact, before the offer price is set, the underwriters work to create a price range reasonable for the issues. They begin a road show in which senior management and lead underwriters travel across countries promoting the company and marketing the campaign. After the road show, customers show their interests through bids which are subsequently gathered in the book. Usually the rationale behind the allocation of shares is that institutional bidders give more information to the underwriters (through limit bids rather than strike bids) about the true value of the stock, and are consequently allocated more shares as a compensation for this costly information.

Another way of allocating shares is through an auction system. The Dutch auction is a famous one. Through this system, the allocation of shares during an IPO is based on price aggressiveness and all winning bidders pay the same price. There is one special version of this auction called OpenIPO. This is based on an auction system using a mathematical model which treats all qualifying bids in an impartial way. These are ranked from the highest to the lowest and the highest are allocated all shares where winning bidders pay the same price. Initially, the auction system was based on a discriminatory system where investors would pay what they had bid, therefore not all would pay the same price.

In general, if the objective of the issuing firm is to reduce risk, probably a traditional IPO may be more effective due to the underwriting support. From the point of view of the investors the Dutch Auction system allows everyone equal “democratic” access. Some

people have also argued that this system is more effective in the “price discovery”, however the bookbuilding mechanism has still the edge on this argument.

These auction systems have been used often during the first years of the 2000s, but then the bookbuilding system has gained advantage mainly due to its information revelation mechanism.

During an IPO there are two different time windows called “quiet periods”: the first is the period following the filing of the firm’s S-1 Form. In this period, issuers, analysts and others are restricted in their ability to discuss the upcoming IPO. The second quiet period refers to the 40-days period following the IPO’s first trading day. Here insiders and underwriters are restricted from disclosing any earnings forecasts or research reports for the firm.

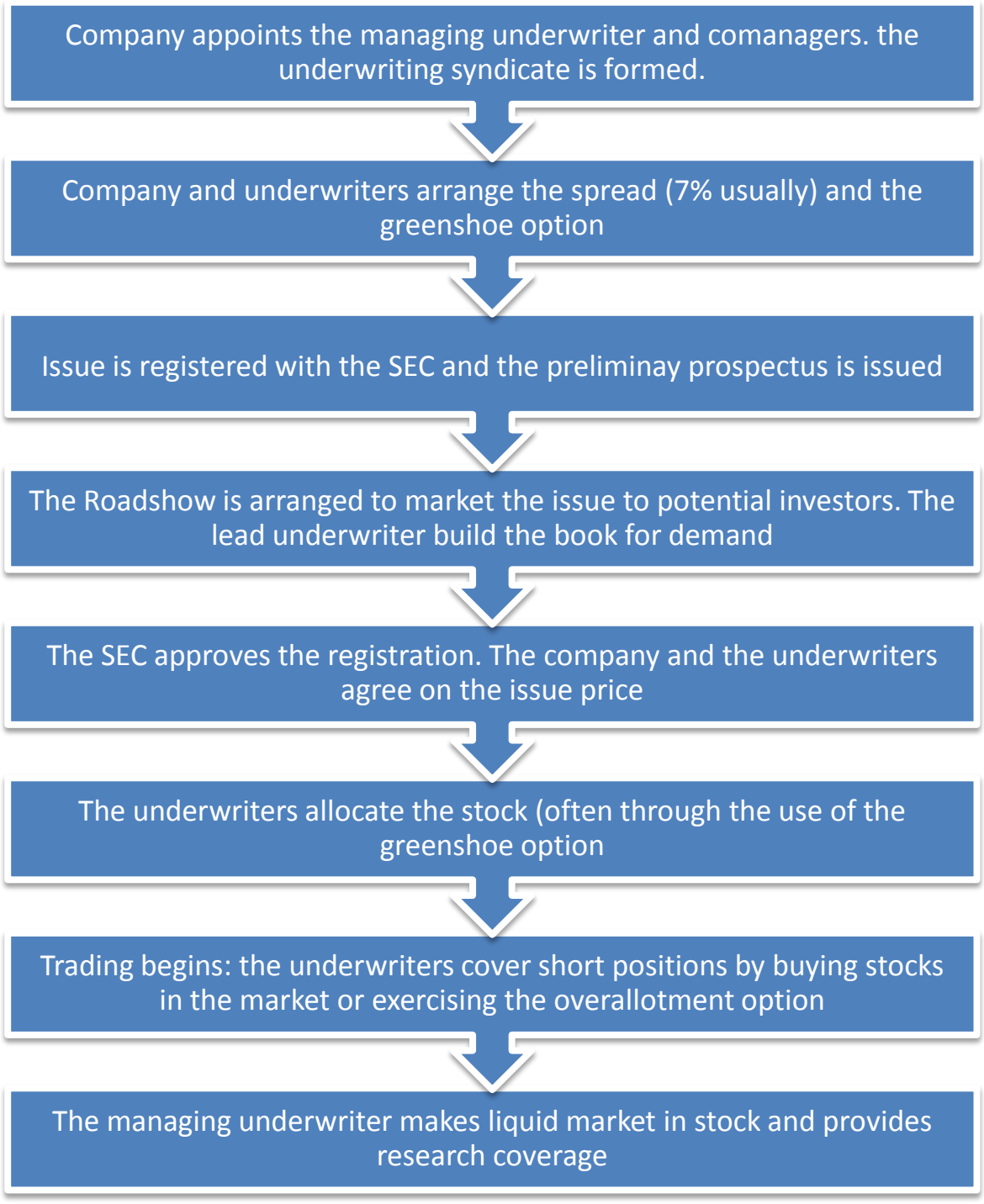
In general, once the due diligence process of the underwriter is complete, this, together with the issuer, determines the final offer price in a “pricing call” which typically takes place after the market closes that day. Here, the managing underwriter proposes a price which must be accepted by the management. Then the securities can be sold to investors.

The underwriter’s concerns (or the syndicate’s concern) is to sell the securities as quickly as possible at the offer price. The speed to which shares are sold is important since the offer price reflects market conditions of the previous days which may quickly change. Usually most of the securities are placed prior to the IPO (often they are all pre-placed). There is a great debate about the fact that underwriters tend to preplace offers excessively due to the problem linked to the firm’s commitment contract. In fact, the risk of undersubscription would entirely fall on the head of the investment bank which, to avoid this risk, will rather pre-sell all the shares.

At the closing of the offering, the issuing firm delivers the security certificates to the investment bank and this delivers the payment for the securities, net of the underwriting fees, to the issuer.

Below it is possible to see a graph representing all the steps which lead a company to being public, from the decision about the underwriter to the beginning of the trading activity.

Figure 1 – The steps defining the IPO process



Source: *Corporate Finance*, Berk, DeMarzo

When dealing with IPOs four characteristics will puzzle readers:

- On average, IPOs are underpriced: the price at the end of the first trading day are much higher than the IPO price
- The number of issues is highly cyclical: in “hot” periods, the market is flooded with new issues and viceversa
- The long run performance of new public companies is very low (for three to five years)
- The costs of an IPO are very high and it is unclear why firms willingly incur them

The first question arising in relation to underpricing is who benefits from it. Investors who are able to buy the stock from underwriters at the IPO price will gain from this first-day underpricing. The cost is entirely borne by the firm, who leaves money on the table.

Regarding the cyclicality, there is a clear pattern which links the volume and number of issues. During the dot-com bubble in 1999-2000, the volume of IPOs was huge. What drives them is not just the demand for capital. It is strange why sometimes firms and investors favour IPOs and other times just rely on alternative sources of funding.

The cost of an IPO is significant. Typically the spread for the underwriter is 7% of the issue price (for an issue of 100 million the underwriter will gain 7 million). This is a large fee, considering the further cost of underpricing which affects the issuing firm. Another problematic is raised by the fact that this spread stays constant despite the change in value of the IPO (whether the size is 10 million or 500 million, the spread stays at 7% on average).

Regarding long-run underperformance, it is strange how IPOs generally perform very well soon after the offering, while surprisingly they underperform in the long-run after three or five years. This is not just unique to IPOs but to subsequent issues as well.

In general, these facts are analysed much more thoroughly in the next chapter, where the discussion involves also models and theories of some of the most influential economists of our times.

1.3 Seasoned Equity Offering

Generally an IPO is not enough for satisfying a firm's need for capital. Thus, very often firms return to equity markets through an offering called seasoned equity offering (SEO). In general, SEOs follow most of the steps of an IPO, where the main difference relies on the fact that the market price for the stock already exists. Historically, intermediaries advertise the sale of stock through advertisement papers called tombstones, so investors would know who to call to purchase shares. Today, news media substitute this system much easily and quickly. There exist two different SEOs: cash offerings or rights offerings.

In the first case, the firm offers new shares to investors at large; in the second case, firms offer new shares only to existing shareholders. Rights offers protect existing shareholders from the problem of underpricing.

Researchers found that the market reaction to an SEO is a price decline and often the value destroyed thorugh this decline is higher than that created through the sale of shares. Since there is smaller underpricing and the company is concerned about protecting existing shareholders, firms generally value correctly the firm, or they overvalue it. This leads investors to infer that SEOs are likely to be overvalued and this results as a price shock.

CHAPTER 2

Literature review: the three main streams

When dealing with initial public offerings (IPOs) both in general terms and in academic ones, it is general use to relate to the past literature which focused on specific aspects of this huge argument. By looking through the decades, the exploit that the IPOs have had as matter of financial discussion is, to say the least, remarkable. The first papers specifically addressed to this argument are those of Ibbotson (1975), which created a wave of interest still growing. Despite the fact that different elements of IPOs have been treated through these years, it is possible to highlight three main literature streams. These have been and are still today the centre of financial discussion when dealing with IPOs. These literary branches are related to the underpricing of the stocks in the IPOs, the waves which characterise the advent of IPOs (or the concept of "hot issue" as best analysed by Ritter in 1984), and the long run underperformance of the stocks.

The problem of the stock underpricing is probably the most discussed and evident one of the three topics: data about the abnormal initial returns gained by investors during the first days of the issuance go further back to the 70s (Ibbotson, Jaffe, Logue), but many other authors contributed to the explanation of this fact. While these authors found that share prices jumped substantially on the first day of trading (an abnormal average return of 11,4% was found for a relatively small sample during 1965-69), Ritter in 1984 and Rock in 1985 contributed enormously to both increasing the empirical analysis and trying to explain the problem. Different reasons for this strange behaviour have been found, showing that not just one variable must be considered, but multiple ones. All these considerations will be treated further below.

Another particular fact that has emerged during the years is that of the IPO waves. Over the last four decades, it has been reported a recurring pattern of cycles of IPOs in both volumes and average initial returns (Jong-Hwan Yi, 2003). This pattern of "hot issue" markets refer to periods of incredibly high volumes of IPOs and high returns, in contrast

with “cold issues” where both tend to decrease (this generally happens at the end of the “hot” period). The first reports about this phenomenon are by Ibbotson and Jaffe (1975) who analysed the years 1960-70. Then, the same topic was intensively addressed by Ritter (1984) who found an abnormally high average initial return of 48,4% during the

“hot issue” period of 1980-81, in contrast with the much smaller figure of 16,3% of the cold period (the remaining period of the years 1977-82). Different hypothesis have been advanced in order to explain this fact, but none of these has perfectly managed to resolve the problem.

The last evident phenomenon related to IPOs is that of the low long-run performance of the shares issued. This was first documented in the 1991 by Ritter who analysed a sample of 1526 IPOs during the period 1975-84. These would have significantly underperformed the market indexes used as comparison. Earlier works of the 60s and 70s report an analogous problem, but the absence of consistent and numerous data may dent the econometric significance of the sample considered. While initially the belief was that long-run underperformance of IPO shares lasted 3 years, Yi (1992) finds that underperformance continues for six years after issuance, and Loghran and Ritter (1995) document low performance just for the first five years. Nevertheless, various theories have been advanced to explain this phenomenon, which is not just American, but present also in the global landscape (Lee, Taylor and Walter, 1996; Aggarwal, Leal and Hernandez, 1993).

In this chapter these three literature streams will be discussed, together with the theories proposed and the problems yet to be solved. A greater space will be dedicated to the underpricing phenomenon for two reasons: it is the most evident and controversial issue of IPOs (and one of the most discussed in the whole financial landscape), and it is still actual today, with different theories which, more or less extensively, manage to explain this problem.

Table 2 – The three main literature streams on IPOs

IPO argument	Main advocates	Contributions
Underpricing	**Logue, Ibbotson (1973, 1975)** **Rock (1986)** **Beatty and Ritter (1986)** **Allen and Faulhalber (1989)**	**First empirical analysis of IPO stock underpricing** **Asymmetric information linked to "winner's curse"** **Underpricing due to underwriter's reputation** **Underpricing of shares as a signal to investors**
"Hot issue" cycle	Ibbotson and Jaffe (1975)	First documentation of the "hot issue" phenomenon with respect to period 1960-70
	Ritter (1984)	Analysis of the "hot issue" market between 1980-81 and possible equilibrium explanation
Long run under-performance	Ritter (1991) Loughran and Ritter (1995) Aggarwal, Leal and Hernandez (1993)	Extensive analysis of the long run performance of IPOs Great empirical analysis with 4753 IPOs in dataset Analysis of underperformance for IPOs in Brazil, Chile, Mexico

2.1 Underpricing

Many companies may decide, when looking for capital to fund its activities, to go public through an initial public offering (IPO). This act has many consequences and apart from direct benefits, many other indirect ones are present. An IPO shines a spotlight on the company (Ljungqvist, 2007) which must be much more transparent with respect to shareholders or public institutions as the SEC, which requires the disclosure of specific information. IPOs have interested economists for long time and the first authors to study them are Logue (1973) and Ibbotson (1975) who documented the underpricing of initial shares for the first time.

This phenomenon characterises IPOs since the 60s, despite the range of underpricing has changed a lot in time. By looking at the table below (Table 3) it is possible to note the huge disparity in terms of initial returns along the different decades in the U.S. In the 60s this underpricing has averaged 21%, in the 70s 12%, 16% in the 80s, 21% in the 90s and 40% since 2000 (Ljungqvist, 2007).

Table 3 – Historical Underpricing figures

Historical Period	Average Underpricing
1960-1970	21%
1971-1980	12%
1981-1990	16%
1991-2000	21%
2000-2004	40%

Source: *IPO underpricing*, Ljungqvist (2007)

If this fact were “harmless”, so to say, the economic literature wouldn’t have spent decades trying to analyse it. Instead, underpricing is very costly for the issuing firm, since money is “left on the table” every year (Ljungqvist, 2007). That is why the biggest branch of economic literature concerned with IPOs deals mainly with initial stock returns and share underpricing, developing theories and models trying to explain the problem.

The main theories brought about by economists under this subject, deal with asymmetric information. Many models have been proposed, on the basis that there was not a uniform informational level among the three key parties of an IPO: the issuing firm, the underwriter and the investors. In this chapter the underpricing issue will be discussed taking in consideration different theories, all with different points of view. Each of these has contributed greatly to the previous economic work and since the amount of data available to these economists has increased in time, the samples obtained to discuss the economic models explaining underpricing have increased notably.

As stated earlier, underpricing is generally calculated as the difference between the offer price (the price at which new IPO stocks are sold to other investors) and the price at which the same shares are traded in the market. Since the extent of underpricing becomes quickly evident after the first trading day, most of the subsequent studies use the first closing day price, the second closing day price or the one that emerges after five to seven days.

One of the most famous asymmetric information model of underpricing is the one proposed by Rock (1986) which focuses on the so called “winner’s curse”. In his best known paper, he suggests the existence of two groups of investors: one whose information is superior to that of the same firm and of the other “uninformed” investors. These informed investors will only bid for attractive IPOs, those with better prices. However, uninformed investors, due to their state of ignorance, will indiscriminately bid for different IPOs. It becomes easy to understand that this will lead to a “winner’s curse” upon uninformed investors: while for unattractive offerings they will receive all shares they have placed a bid for, in attractive offerings they will be crowded out by the other informed investors (Ljungqvist, 2007). Therefore, it will be created a situation where the average initial return conditional upon receiving some shares is lower than the initial

average return conditional upon submitting the purchase order (Beatty, Ritter, 1986). Since the market needs the participation of these uninformed investors, due to their contribution to demand, the conditional expected returns mustn't be negative, or the uninformed investors will decide not to purchase any share. The direct consequence of this line of reasoning is that IPOs must be underpriced. Obviously the winner's curse still exists; the only difference will be that uninformed investors won't be making losses on average.

Rock (1986) therefore assumes that there is a cost-benefit analysis that the firm must carry out when dealing with IPOs: on one side the cost of underpricing is big since the amount of money "left on the table" is remarkable; on the other side the issuing firm necessitates of uninformed investors purchasing their shares, so underpricing becomes mandatory. Michealy and Shaw (1994) state that if the information is distributed more homogeneously across investors, the winner's curse will eventually disappear together with any reason to underprice.

Beatty and Ritter (1986) wrote a famous paper developing mainly two different propositions: there would be a monotone relation between the underpricing of an IPO and the uncertainty of investors with respect to its value and that the underpricing equilibrium is maintained by bankers who have reputation at stake. Beatty and Ritter (1986) define the uncertainty of the value per share which will be traded in an IPO as "ex ante uncertainty". As stated earlier, the higher this uncertainty, the greater the expected underpricing will be. Another key aspect in their discussions is that the investment bank will enforce the underpricing equilibirium. Infact, not only will the underwriter be involved in many different IPOs, but this must be careful not to underprice too little or too much which would respectively penalize the investors or the issuing firm.

One of the main characteristics of IPOs is quantity rationing. Once the initial offering price is set, any excess demand for the issue offered to investors paves the way for quantity rationing, instead of a further offering price adjustment (Beatty and Ritter, 1986). This rationing, however, doesn't happen randomly among all issues and that is why the "winner's curse" becomes apparent to those investors who will find themselves granted with the stocks they have placed a bid for. The informed investors become so

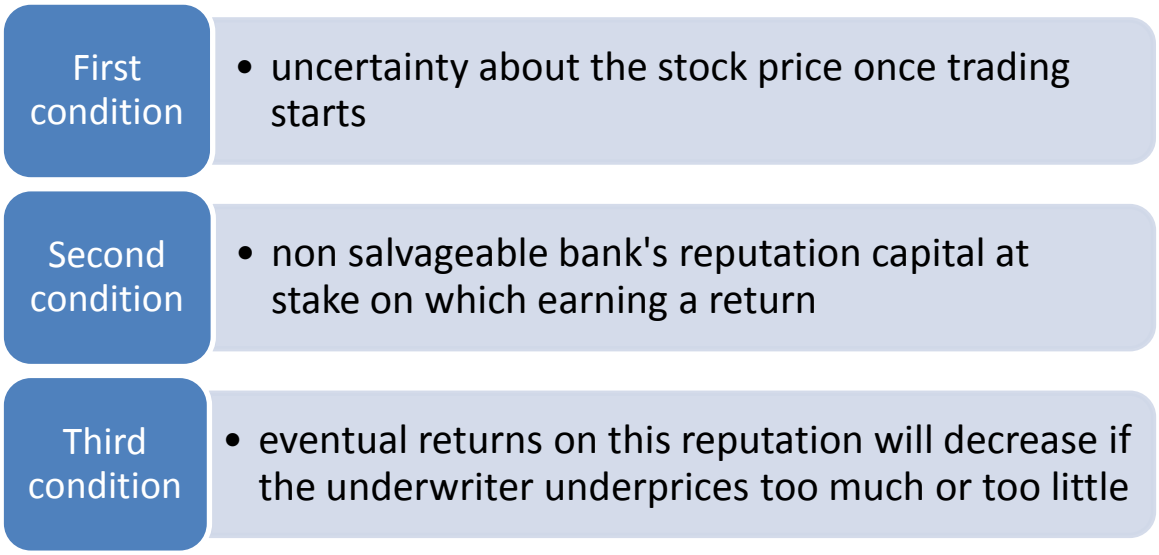
through a cost, namely the cost of information. That is why they'll earn on average a positive return in the IPO. This return however will be necessary to cover the costs of gaining the information which shifts them from being uninformed (and therefore subject to the winner's curse) to informed.

The uninformed investors or "free riders" will submit purchase orders only if initial public offerings are underpriced. So it is possible to notice that as the "ex ante uncertainty" increases, the winner's curse phenomenon becomes stronger (Beatty and Ritter 1986). The corollary of this simple statement is that "free riders" will be willing to invest in IPOs and therefore to suffer from the "winner's curse" only if there is money "left on the table" through the underpricing mechanism.

This leads to the first proposition stated by Beatty and Ritter (1986*): The greater the ex-ante uncertainty about the value of an issue, the greater the expected underpricing.*

A problem however becomes apparent: what stops a firm going public from "cheating" the market and setting a too high offering price? The key lies on the difference between the main protagonists of the IPO: the issuing firm and the managing underwriter. While the first participates only to one IPO, the second will (probably) participate in many more and this repetitive business with investors will also develop a reputation on which the investment bank may gain returns. Beatty and Ritter (1986) write that three necessary conditions must occur for an investment banker to enforce the underpricing equilibrium: the bank must be uncertain to the price fluctuations of the newly issued share; the bank must have the possibility to earn returns with respect to its reputation at stake; the underwriter will lose this reputation whether it "cheats" underpricing too much or too little.

Figure 2 – Three necessary conditions for the underpricing equilibrium enforcement



Source*: Investment banking, reputation, and underpricing of IPOs*, Beatty and Ritter (1989)

While the first condition is rather clear (if there was no uncertainty, underpricing wouldn't exist since the underwriter could perfectly price the shares), the other conditions need more attention. What is meant by having "good reputation" is for the bank the willingness not to behave opportunistically, but rather building up goodwill and earning returns in the form of fees or lower distribution costs (Beatty and Ritter 1986). Therefore is clearly understood that if the underpricing is too small (so the stock price is high), the bank will lose customers (more specifically they will lose those investors subject to the "winner's curse"). On the other side, if the underpricing is too high, then potential issuers will stop doing business with this underwriter. Since the amount of underpricing is linked to the ex -ante uncertainty of the issue's value, and the same underpricing is also related to the possible loss of market share by the bank, this leads to the second proposition by

Beatty and Ritter (1986): *Underwriters whose offerings have average initial returns that are not commensurate with their ex ante uncertainty lose subsequent market share.*

In order to empirically test these propositions, IPO studies focused on controlling for this ex ante uncertainty using many different proxies. The most famous ones refer to company specific characteristics, prospectus information, age of the firm or size. More specifically, Beatty and Ritter (1986) used gross proceeds and the amount of uses of proceeds disclosed in the prospectus. While it is common knowledge that the smaller offerings are more speculative than bigger ones (and therefore riskier), the adoption of the proceeds' uses as proxy is more subtle. The key to understand this stands on legal grounds mainly: on one side firms are very reluctant to give information about a firm's decisions on how to exploit the proceeds, on the other the SEC (Securities and Exchange Commission) requires more speculative issues to provide specific information about uses of proceeds (Beatty and Ritter, 1986). Therefore it is clear that where many enumerations of uses of proceeds are listed, then the ex-ante uncertainty is much greater.

However, many economists argue that this approach may be improved by identifying the risk factors that indicate higher uncertainty (Ljungqvist, 2007). A study by Ljungqvist and Wilhelm (2003) argues that when firms state in their prospectus that they intend to use their IPO proceeds for "operating expenses" instead of investment or for example debt repayment, are much more risky.

2.1.1 Information Revealing Theories

Another branch of the literature regarding IPO underpricing deals with information revelation theories. As written above, Rock's (1986) main argument of asymmetric information spread among the different key actors in the IPO give raise to the "winner's curse". Some investors are more informed than either the firm or other investors, and for the company issuing shares becomes of capital importance to elicit information from informed investors before setting the price. Obviously for investors there is no incentive in revealing information to the underwriter, sine the only consequence would be paying a

higher price for the newly issued shares. On the contrary, there is a strong incentive to misrepresent information in order to obtain a lower issuing price. So one of the difficulties that investment banks face is to create a mechanism which will induce investors to reveal their information in a truthful manner, incentivising them to do so (Ljungqvist, 2007).

Benveniste and Spindt (1989) define two different types of informational frictions in the IPO pricing: one friction exists due to the fact that issuing firms asymmetrically better informed than others about their business status (and therefore they have an incentive to show themselves as a high quality firm, often misrepresenting reality); another friction is the fact that investors are likely to be better informed about the facts happening outside the boundaries of the firm. It is clear that these information asymmetries increase the difficulty in correctly setting the issuing price of the shares. Benveniste and Spindt (1989) then create an auction based model of the premarket where investors understand how their different expressions of interest affect the offering price and share allocation.

Underpricing is then considered as a natural consequence of this premarket auction where IPO prices are set low to compensate investors for revealing information to the underwriter, yielding them some profit (Benveniste and Spindt, 1989). Compensation is directly related to the amount and quality of information revealed, which is also linked to the extent to which withholding information will benefit investors by resulting in a lower initial price.

One can argue that in this kind of scenario, there is no need for an underwriter since its contribution is rather small: the issuing firm may simply gather its premarket information by itself. This would be correct in theory if the game was “played” just once: since IPOs are repeated by underwriters who generally deal with more than one during its existence, the bank may repeatedly deal with regular investors who will then receive priority in the allocation of shares, granting them high returns. This leverage can therefore be used by investment banks to reduce the amount of underpricing.

Another paper from Benveniste, Busaba and Wilhelm (2002) deepens the concept of costly information production by the underwriter when deciding the issuing price. There is a link between the ability of the bank to “bundle” IPOs in time and the observation that

IPOs tend to occur in waves (Benveniste 2003). The key is that valuation uncertainty is characterised by two elements: one firm-specific and an industry component. Therefore by gathering information about the industry component makes it easier and cheaper to evaluate other future and potential IPOs in the same industry. Since there's the risk that the first firms going public in a specific sector are disadvantaged to do so (they would have to underprice in greater magnitude), to avoid negative externalities of this kind, the underwriter may compensate regular investors for the information costs across a series of offerings (Ljungqvist, 2007). That is why often investment banks tend to specialise in particular sectors and industries (and why companies prefer to go public in industry specific waves).

In order to test whether investors revealing more information to underwriters tend to receive a greater allocation of shares, Cornelli and Goldreich (2001, 2003) had the chance to handle the IPO books of a prestigious European investment bank (IPO books are generally private so this is a very exceptional case and the name of the bank is anonymous). What emerges is that mainly two types of bids are made: strike offers and price-limited bids (while the first kind specifies a quantity and price for the shares, the second type just limits the maximum price the investor is willing to pay for any amount of shares). Since the second kind of bids obviously reveals more information to the underwriter, it would be predictable for these investors to receive a greater allocation of stocks for them to be compensated.

Cornelli and Goldreich (2001) find that in general price-limited bids are granted 19% greater allocations than strike offers. So investors who placed price-limited bids received on average greater amounts of shares. Another pattern which emerges is that frequent investors receive greater allocations than the so called "free riders", in line with what has been written above.

When comparing this result with a very different one carried out by Jenkinson and Jones (2004) we obtain diverging results: while the first study was taken with respect to an American bank, the second one deals with a European bank. Many differences stay uncontrolled for (different market's activity, connections, bookbuilding system). Moreover, Ljunkvist, Jenkinson and Wilhelm (2003) show that when U.S investment

banks are carrying out the deal with U.S investors, underpricing is reduced by 41,6%. Despite this result might seem astonishing at first, U.S banks charge higher underwriting fees than other banks so the result is in some way misleading.

Regarding the same problem of allocation of shares between frequent and infrequent investors, Hanley and Wilhelm (1995) obtained interesting results using a sample of 38 U.S IPOs carried out by an apparently prestigious investment bank during the years 1983-88, trying to prove that institutional investors were allocated more shares than simple "free riders". The result is that institutional allocations are 66,8% of the average IPO (Ljungqvist, 2007).

2.1.2 Principal-Agent Theories

Another branch of economic literature dealing with IPO underpricing focuses on agency problems: those arising between the investment bank and the issuing firm. Loughran and Ritter (2004) are probably those who most prominantly emphasised this problematic. A risk which may arise during an IPO is that of side payments made by investors to underwriters in order to increase underpricing or change the allocation of shares (Ljungqvist, 2007). Another less common practice is that of "spinning": underwriters allocate stocks to high executive members of other firms hoping to gain their collaboration or business in future.

In order to avoid this kind of collusion, underwriting fees are generally paid according to the proceeds raised, and therefore it would be inversely related to underpricing. It may happen, however, that the investment bank may gain more by colluding with investors, deviating from the agreement signed with the issuing firm. In 2002 Credit Suisse First Boston was fined for 100 million due to side payments received in order to increase underpricing in an IPO.

There are mainly two ways through which agency problems may be solved: either monitoring the bank in an intensive way, or using a contract which links offer price to

compensation (the higher the former, the higher the latter). Despite the fact that Ljungqvist (2007) shows that contracting on higher commissions in UK IPOs has led to lower underpricing (a case where underwriter's compensation is related to issuer's valuation), there are two different tests that may be done in order to solve the problem. It is sufficient to find IPOs carried out by underwriters who own equity in the issuing firm (therefore no asymmetry exists), or a situation where the IPO is carried out by the same firm without the use of an investment bank.

Logically it would be natural not to find any underpricing in these two cases, but Muscarella and Vetsuypens (1989), when analysing a sample of 38 firms who were also underwriting themselves between the 1970-80, have found that underpricing still existed, even though there was no agency problem. Due to the small magnitude of the sample, the findings are not strictly significant; Ljungqvist and Wilhelm (2003) instead found that when underwriters held shares of the issuing firm, underpricing was much smaller, highlighting the importance that agency problems have in the whole IPO literature.

2.1.3 Signalling by Means of Underpricing

The last group of models dealing with asymmetric information are related to the branch of signalling theory. Allen and Faulhaber (1989) go directly in contrast with Rock (1986), stating that it is the issuing firm who has better information about the business than investors or the underwriter, and therefore the company may find it optimal to signal its true high value by underpricing the newly issued shares.

The main concept of this model partly elaborates Ibbotson's idea (1975) that IPOs are underpriced to "leave a good taste in investors' mouths", and the issuing firm will gain profit from subsequent eventual IPOs which can be sold at better prices. Since underpricing is very costly for the firm, then the signal might be effective, since only the companies which are solid profitable may recoup the loss with future performance (Allen and Faulhaber, 1989).

An example may simplify the assimilation of this idea. Suppose there are two different kinds of firms: high quality firms and low quality ones which, however, appear the same to investors. If this was a one-time game there wouldn't be any incentive for firms to underprice to signal investors that theirs is a good company. But supposing that the game repeats, and therefore after the IPO subsequent issues may occur, the scenario changes significantly. High quality firms have the incentive to signal, by underpricing, that their firm is sound and based on solid financial and operational grounds. Initially the low quality firm will have the incentive to mimic any kind of behaviour of the high quality firm. However, it is reasonable to believe that before the post-IPO stage of financing investors will discover the true nature of the firm, whether it is a good one or not (Ljunqvist, 2007).

Due to the risk of being caught mimicking a profitable firm when not being one, low quality firms don't have the incentive to do so. A separation between the two types of firms becomes possible, and the high quality firm is willing to leave "money on the table" during an IPO in order to grant profits to investors. Subsequently, in future offerings the underpricing will be less significant and the high quality firms will manage to recoup the loss incurred previously to distinguish itself from the rest of the companies.

An important question arises: would the firm use this signal if it had at its disposal a bigger range of possible ones? Is this the only effective signal, despite its cost being significant?

Allen and Faulhaber (1989) suggest that there are different ways for firms to signal their quality to investors: two famous variables used are the underwriter's choice and the auditor's choice (other variables are the quality of the Board of Directors, of bank loans etc.). Differently from these other possible signals, underpricing has more positive advantages. Infact, it reduces the chances the firm will be sued in lawsuits if the firm doesn't perform well after the IPO; or, underpricing may put the firm in a spotlight of media and public opinion (many newspapers and journals list the "best IPOs" as those with the highest percentage increase from issuing price to current price).

In general, underpricing is the most evident and common feature in IPOs. Papers quoted above range from the 1970s to 2000s, showing that this phenomenon is still today of great importance and actuality. Many different theories have been brought about by economists, and each one of these had the tough job of spreading the circle, rediscussing all the previous work and increasing the magnitude of eventual datasets in order to obtain a more significant argument. This is however just one of the three main topics that characterise IPOs, the other two being "hot issue" waves and long run underperformance of IPO shares. In the scenario of underpricing just described, it would sound strange for a firm to gain abnormal returns in the short run, but underperforming in the long run against most of the stock indexes. This phenomenon, together with IPOs occurring in waves and cycles, will be discussed in the next subchapters.

2.2 "Hot Issue" Markets

The second literary stream which characterises IPOs is focused on the fact that they tend to follow in waves or cycles. Not just the average initial returns tend to be in series, but also the IPO volumes. This specific pattern which was first observed by Ibbotson and Jaffe (1975) is called "hot issue" market phenomenon.

The most famous paper dealing with this problem was written by Ritter (1984) who analysed the "hot issue" market of 1980-1981. He documents an initial return on shares of unseasoned issues of 48,4%, which compared with an average of 16,3% during the opposite period ("cold issue"), gives an interesting result. The analysis was made with respect to two different periods: the first 15 month period starting in January 1980 (the "hot" period) and the rest of the 1977-1982 period. The first question arising when dealing with these markets is why do they occur. It is of huge importance to understand this, since a predictable behaviour of stocks could be used by investors to gain profits and goes against the concept of "perfect market behaviour".

Ritter (1984) first considers a point highlighted by Rock (1982): IPOs with high risk tend to be underpriced more than low risk offerings. It is possible that during "hot issue" markets the initial offerings which are carried out have a much higher degree of risk, and

therefore are subject to a greater underpricing. Ritter (1984) tests this explanation, however it is not sufficient: the change in risk composition doesn't explain the abnormal returns recorded for that period. What he discovers is that they can be attributed to the natural resource issue. The empirical analysis performed by Ritter (1984) will be discussed below.

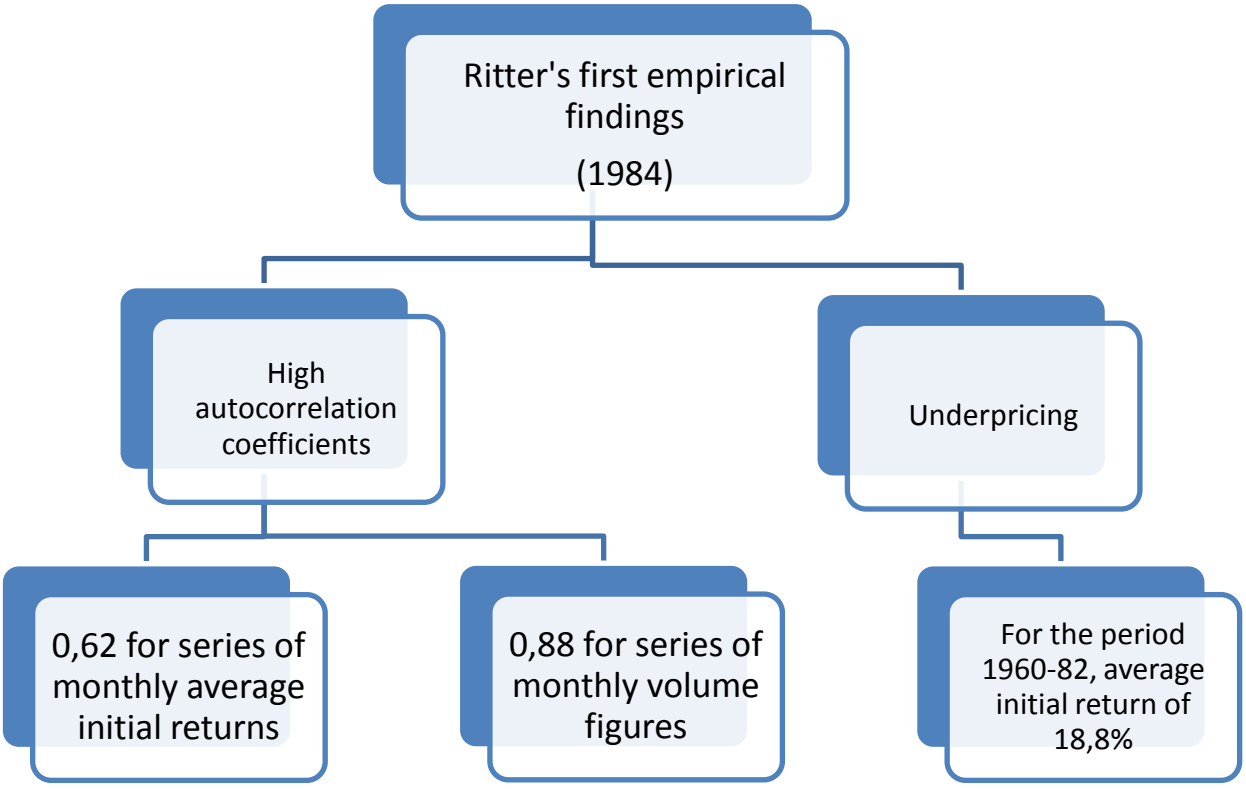
2.2.1 Empirical Analysis of the Hot Issue market

The sample which is used by the author to discuss his theories is composed by 1075 U.S companies who have carried out an IPO during the years 1977-82. The IPO's initial return has been computed considering the first day price's bounce (even though for some shares, prices were disclosed with a lag of a few days). Then, for each month between the beginning of 1960 and the end of 1982, the weighted average initial return was calculated and plotted in a graph.

Mainly two different characteristics emerged during these six years: first of all there was evidence of underpricing (some IPOs had initial average returns of more than 100%); secondly, there is a high degree of autocorrelation between the average returns for each month (Ritter, 1984). The first order autocorrelation coefficient resulted 0,62 which is greatly significant (being far from zero).

In a second graph it is plotted the volume of IPOs by months, with the same procedure adopted earlier. In this case, the autocorrelation coefficient is even more robust, being equal to 0,88 for the period 1960-1982. As stated earlier, this cyclical recurrence is hardly explainable just by casualty. Moreover, these two emerging patterns contrast with the notion of market efficiency (Ritter, 1984), since they might be predictable for future years too.

Figure 3 – Representation of Jay R. Ritter's empirical evidence



In order to explain the existence of IPO waves, Ritter amplifies Rock's theory of underpricing (1982). In the model, both the firm and the underwriter are uncertain about the value of the shares to be issued. Due to asymmetric information, two groups of investors are distinguished: informed investors and uninformed ones. The former however, are willing to pay a cost only if the value of the shares will be lower than their true value (or else they will incur in a profit loss). This creates a situation where uninformed investors suffer from a "winner's curse": if they are allocated shares in an IPO, there is a high chance that the offering will be an unattractive one. On the other hand, uninformed investors are willing to submit a bid only if the expected return conditional on placing a bid is non-negative (Ritter, 1984). It might be expected that, the higher the degree of uncertainty (and risk) in an IPO, the stronger the underpricing will

be (since the cost of becoming informed increases). So an implication of Rock's model is that riskier companies should present higher initial average returns than less riskier firms.

This may be an explanation for the existence of "hot issues": if in one period a large number of risky firms become public, the average level of underpricing increases, in contrast with periods of "cold issues" where the opposite happens.

Ritter (1984), in order to prove that riskier firms (harder to value) who go public suffer from a stronger underpricing, uses two different proxies to measure risk: one based on previously observable accounting information and one based on post-IPO share returns. Moreover, to analyse the changing risk composition, Ritter (1984) divides firms in three different risk categories, using a proxy for the difficulty in valuing a firm. The proxy used is annual sales: the rationale is that firms with smaller sales are also smaller firms, more recently established and would display a higher level of risk in an IPO, since it is more difficult to value.

Table 4 – Ritter's empirical evidence on "Hot Issue" markets

Sales category	Hot issue	Cold issue	Hot - Cold
Sales < $500,000	**70,9%**	**27,2%**	**43,7%**
$500,000 < Sales < $4,000,000	**35,7%**	**10,3%**	**25,4%**
Sales > $4,000,000	**9,6%**	**15,4%**	**7,7%**

Source: *The "hot Issue" Market of 1980,* Ritter (1984)

For the period highlighted through the table (Table 4) , it is evident that firms with lower sales (and therefore higher risk) show a significant higher average initial returns than larger sales firms do. Despite the table being supportive to Rock's model, it doesn't

explain effectively the "hot issue" market. Infact, it might be that the risk among the different categories is not held constant.

Ritter (1984) analyses the behaviour of companies involved in natural resources, in order to find a possible element which disturbs the calculation of risk made above. During the 1980s, many natural resource-related firms went public: many of them were start-ups, and the IPO peak decreased one year later. In order to understand the influence that this boom may have had on the "hot issue" market, it is possible to repeat the previous table, distinguishing whether the firms involved belong to the natural resource sector or not.

Table 5 – Hot and Cold Issue market's data comparison

Type of Issue	**Hot Issue**	**Cold Issue**	**Hot-Cold**
Natural Resources			
Sales < $500,000	**140,4%**	**23,9%**	**116,5%**
$500,000 < Sales < $4,000,000	**48,1%**	**12,3%**	**35,8%**
Sales > $4,000,000	**32,7%**	**2,1%**	**30,6%**
Nonnatural Resources			
Sales < $500,000	**23,6%**	**28,9%**	**-5,3%**
$500,000 < Sales < $4,000,000	**31,9%**	**9,9%**	**22,0%**
Sales > $4,000,000	**11,8%**	**8,3%**	**3,5%**

Source: *The "hot Issue" Market of 1980*, Ritter (1984)

The table (Table 5) clearly shows that there is barely no "hot" or "cold" issue market for non-natural resource-related firms. The differences between the two periods are small,

fluctuating around 5%. For natural resource-related firms however, the "hot issue" market is evident: for highly risky firms (those with sales less than $500,000) the difference between "hot" and "cold" issue is 116,5% and decreases as the degree of risk diminishes (Ritter, 1984).

Evidence showed does not support the idea that changing risk composition is at the base of the "hot market" in 1980. On the contrary, the initial high returns are due to the "non-stationarity" of the returns in the natural resource issues (Ritter, 1984). Moreover, it exists a positive relationship between risk and average initial returns.

Ritter (1984) also compares two different graphs: one where the natural resource sector issues are plotted, and the other composed by non-natural resource issues. When calculating the autocorrelation of the initial returns (computed on a monthly basis), it is obtained a value of 0,27 for the latter, while 0,5 for the former. The difference is significant, and it strengthens the idea that the "hot issue" market was confined only with respect to the natural resource sector IPOs.

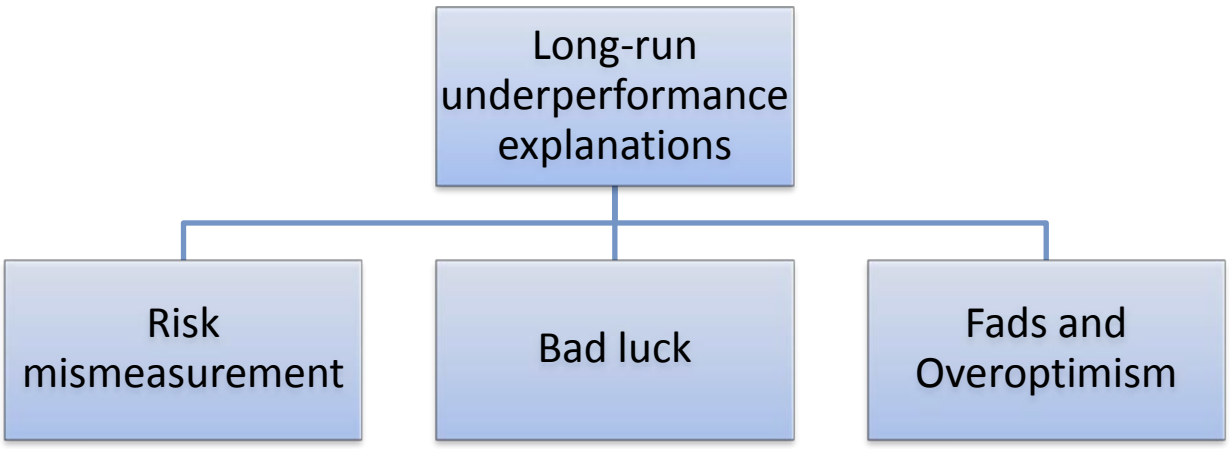
2.3 Long-Run Performance of IPOs

In the IPO literature, two phenomena have been extensively documented: the underpricing of the new shares, and the "hot issue" market phenomenon. One of the first economists to document and analyse thoroughly long-run underperformance in IPOs is Ritter (1991). This problem was initially taken in consideration by Ibbotson (1975) and other authors, but the difficulty in finding data available and the small magnitude of samples used have made these papers less empirically significant than they could have been. Ritter (1991) instead uses a sample of 1526 U.S IPOs during the years 1975-84 and discovers that within the first three years of their public existence, these firms have significantly underperformed a set of firms belonging to the same size category and industry, used as comparison.

His findings can be summarized with the help of some numbers: the average holding period return (HPR) for the previously described sample is 34,47% during the three years after the IPO, whereas the control sample of 1526 listed stocks used to match the first sample, produced an average total return of 61,86% during the same period. Therefore the long run IPOs' underperformance becomes evident.

Ritter (1991) proposes three different explanations for this phenomenon, and analyses each one of them thoroughly to find the most robust: risk measurement; bad luck; fads and overoptimism. To understand if risk measurement may account for the underperformance, the author uses some benchmark portfolios. Ritter also separates the bad luck explanation from the fads explanation by using cross-sectional and time-series patterns.

Figure 4 – Three possible explanations for Long-run underperformance of IPOs



2.3.1 Empirical Analysis of Long run Performance

The sample analysed by Ritter (1991) comprises 1526 IPOs during 1975-84 which must meet different requirements: an offer price greater than $1 per share; gross proceeds greater than $1,000,000; the offering must involve only common stock (not units); an

investment bank must take the company public. In order to evaluate long-run performance of IPOs, two measures are adopted: the CAR (cumulative average adjusted returns) and the returns from a 3-year holding period for both the IPOs and some matching firms (public firms whose returns would be compared to IPOs belonging to the same industry) (Ritter, 1991). The adjusted returns are calculated using different benchmarks as comparison. Ritter than calculates the returns on two different intervals: one interval lasts one day (computing the difference in offering and closing price of the first listed day) and is defined as month 0, and then the aftermarket period (36 months).

Ritter (1991) then computes the firm-adjusted returns (AR) and the CAR (cumulative average matching firm-adjusted returns) for the whole 36 month period for the sample considered. The results are striking: 31 of the 36 monthly returns are negative (and 13 of them have t-statistics smaller than -2.00). The CAR declines steadily and reaches -29,13% at the end of the 36^{th} month. The underperformance found is also statistically significant.

On a separate graph Ritter (1991) plots the raw returns, the matching firm-adjusted returns and other index adjusted returns. The raw returns reach 42,49% on the 34^{th} month; however, if the returns are adjusted to the NASDAQ or CRSP, the returns drop negative in the long run. For example, the small firms suffer mostly from the adjustment procedure: when the average small-firm adjusted returns are plotted, the CAR amounts to -42,21% after the 36 month period.

With the aim of explaining long-run underperformance, Ritter (1991) exploits different cross-sectional and time-series graphs. In the first one (Table 6), firms are divided according to gross proceeds of the offer. The idea is that smaller offers, being in general more risky and so with highest adjusted initial returns, tend to perform worst in the long run.

Table 6 – A comparison of IPOs based on different amounts of gross proceeds generated

Gross proceeds	Average adjusted initial return	Average 3-year holding period return	
		IPOs	Matching firms
$ 1,000,000 – 2,999,999	**27,45%**	**17,94%**	**67,64%**
$ 3,000,000 – 4,999,999	**18,00%**	**20,89%**	**58,72%**
$ 5,000,000 – 9,999,999	**11,28%**	**40,06%**	**69,87%**
$ 10,000,000 – 14,999,999	**7,51%**	**46,25%**	**55,99%**
$ 15,000,000 – 24,999,999	**10,09%**	**43,97%**	**50,56%**
$ 25,000,000 – 353,950,260	**9,96%**	**39,81%**	**62,50%**

Source: *The Long-Run Performance of Initial Public Offerings*, Ritter, 1991

The evidence is that average initial return decreases as the gross proceeds increase, meaning that the bigger the firm (on average), the smaller the underpricing. Moreover, when the 3-year holding period return (HPR) is calculated for both IPOs and Matching firms, another problem becomes evident. As the public firms become larger (so when gross proceeds increase), the long-run underperformance decreases. While the Matching firms' HPR varies little with the size of the proceeds, the IPOs are very sensitive to proceeds, with large variations too (the range of the holding period return is 17,94 - 46,25). The idea of small firms underperforming in the long run has already been discussed above in the chapter about underpricing. The rationale is that smaller firms are more risky since information about the company is difficult to obtain to do the recent history. This uncertainty (ex-ante) leads the IPOs to be severely underpriced.

Furthermore, as time passes, investors gain information on the firm and a company's history is built: during the first years, the valuation is adjusted, and the general downward revision of the firm's characteristics (financial, operational or in terms of future prospective) leads in the long run to underperformance, compared to other firms in the same industry.

In another table (Table 7), Ritter (1991) reports the long-run performance measures segmented by industry. The aim is to understand whether there are external elements related to the working sector which may influence the performance of these firms. In the table, financial institutions have had the most positive long-run performance (the drop in the interest rates during the years 1985-1986 has helped considerably), while oil and gas firms have strongly underperformed. However, the severe decline in oil prices in the years 1981-83 have dented this industry, so the underperformance shouldn't be surprising. The fact that underperformance in so many industries relative to other companies in the same sector may be evidence that "fads" exist (rather than addressing the explanation as just bad luck) (Ritter, 1991).

Table 7 – A comparison of IPO returns across industries

Sector / Industry	Average adjusted initial return	Average 3-year holding period return	
		IPOs	Matching firm
Oil and gas	**30,92 %**	**-43,86%**	**34,67%**
Scientific instruments	**20,96%**	**18,14%**	**72,20%**
Wholesales	**16,95%**	**1,42%**	**47,14%**
Electronic equipment	**14,59%**	**29,93%**	**61,46%**
Health care	**14,12%**	**36,93%**	**53,25%**
Retailers	**7,60%**	**54,05%**	**113,63%**
Airlines	**6,26%**	**61,62%**	**42,93%**
Financial institutions	**3,69%**	**128,21%**	**59,23%**

Source: *The Long-Run Performance of Initial Public Offerings*, Ritter, 1991

The table above shows that there is a great disparity in the average matching firm-adjusted initial returns along sectors. The biggest difference may be seen comparing the oil and gas sector (30,92%) to the financial institutions one (3,69%). Moreover, the 3-year holding period return of the two industries is -43,86% for the Oil and gas against 128,21% for the IPOs in the Financial sector.

Ritter (1991) then builds a third table, segmenting firms according to their age at time of issuance (calculated subtracting the year of founding from that of the IPO). From this table it is shown a monotone relationship between age and aftermarket performance. The opposite pattern is highlighted regarding the average matching firm-adjusted return (average initial return): the riskier the firm, the greater the number (age can be considered as a proxy for risk). Differently from the graph using gross proceeds as proxy for risk, this is more precise: infact gross proceeds accounts for the misleading fact that larger

issues are made by more established firms, but at the same time a larger issue will be made by a firm when market conditions are optimal (stronger demand). It is therefore difficult to distinguish between these two elements.

However there are problems also for this third table: generally the oldest firms are financial institutions which, as stated earlier, have had great returns in these years. On the contrary, many of the youngest firms belong to the Oil and gas sector which suffered from a negative performance. Therefore below is reported the table (Table 8) without these two sectors which may send misleading evidence. Despite controlling for the two industries, the results don't change in a dramatic way: the "younger" and the riskier the firm, the greater the underperformance, and the same pattern is revealed for underpricing (measured by average initial return).

Table 8 – A comparison of IPO returns according to the companies' different age

Age (years)	**Average adjusted initial return**	**Average 3-year holding period return**	
		IPOs	Matching firms
0 – 1	**23,87**	**16,19**	**76,31**
2 – 4	**14,87**	**19,22**	**53,20**
5 – 9	**13,71**	**33,01**	**65,47**
10 – 19	**9,32**	**42,97**	**67,66**
20 - up	**5,41**	**63,76**	**70,37**

Source: *The Long-Run Performance of Initial Public Offerings*, Ritter, 1991

To conclude, the emerging patterns are that underperformance is a concern of mostly young companies who went public in the high-volume years of the 1980s. Even though this pattern doesn't exclude bad luck as explanation for underperformance, it is more

reasonable to think that this is due to firms going public irrationally and over optimistically. This may be considered as the “fads” explanation (Ritter, 1991).

2.3.2 Investors’ opinion matters!

Another analysis of long-run IPO underperformance comes from Edward M. Miller (2000) who tries to explain it as a result of divergence of opinion of investors and its change in the initial market price.

The first question to be raised is for how long do IPOs underperform market indices used as match. Loughran (1993) examined a sample of 3556 IPOs between the years 1967-87 and found a 6-year return of 17,29%. By comparing this with the 76,23% of the NASDAQ index during the same period, it would be reasonable to extend the underperforming period for more than just 3 years, as Ritter (1991) had sustained. Later on however, both Loughran and Ritter (1995) analysed IPOs during 1970-1990, discovering an average return of just 5% per year for the first five years against a 12% of the matching firms. It is important to notice that many of these studies involve overlapping periods and that samples include those previously used, growing as years pass.

Another interesting fact is that most of the empirical papers written about underperformance deal with U.S IPOs and markets. Underperformance of initial offerings is not just an American phenomenon. In the table below (Table 9) are reported different findings in different countries, and it is clear that this peculiarity is not just restricted to the U.S but is rather global.

Table 9 – Long run underperformance: a global phenomenon

Author	Sample characteristics	Underperformance
Levis (1993)	3 year HPR; 712 UK IPOs	**8,3% - 23%** (depending on benchmark)
Uhlir (1988)	1 yeah HPR; German IPOs	**7,4%**
Finn & Higham (1988)	1 year HPR, 93 Australian IPOs	**6,52%**
Kunz & Aggarwal (1994)	42 Swiss IPOs	**6,1%**
Keloharju (1993)	3 year HPR, Finnish IPOs	**20,8%**
Aggarwal, Leal & Hernandez (1993)	3 year HPR, Brazilian IPOs	**47%**
	3 year HPR, Chilean IPOs	**23,75**
	1 year HPR, Mexican IPOs	**19,6%**
Dawson (1987)	1 year HPR, Hong Kong IPOs	**9,3%**
	1 year HPR, Singapore's IPOs	**2,7%**

Source: Long run underperformance of initial public offerings: and explanation, Edward M. Miller

The key to understand long-run IPO underperformance is, according to Miller (2000), due to divergences of opinions among investors. It is common knowledge that valuation of stocks doesn't follow an objective set of rules. On the contrary, the discount rate at which securities are calculated may differ substantially. This leads to different valuations and therefore different opinions about a same stock. That is why the market is characterised by heterogeneous expectations and not homogeneous ones. Miller (2000) states that due to different opinions about a same issue, the market clearing price won't be at perfect equilibrium. Infact, while there is an average valuation which pushes the

price towards a stable equilibrium, there are other investors who apply a different force. If these investors, due to different opinions, are more optimistic, the market clearing price will be higher (these investors can be considered as outsiders who influence the mean value of the stock price).

However, as time passes, the company will start developing a proper operating history. The initial divergence of opinion which caused the stock price to shift upwards, will decrease slowly, meaning that the existence of more information about the firm will create a common ground for all investors. This means that the price will start decreasing since those "optimistic" investors who had a different valuation will move towards the rest of the investors, reducing the opinion gap. As the price decreases, so does the stock performance

Evidence of this gap reduction may be found in Finn & Higham (1988): they studied 93 Australian IPOs and calculated their beta (according to the CAPM). The results were that during the first month of trading, the stocks had a very high beta (3,35) but already during the second month, it dropped to 1,45. This can strengthen the position of Miller (2000) that divergence of opinion tends to decrease as time passes, and that can be a major cause of long-run share underperformance. Regarding his sample, Ritter (1991) reported a first-year beta of 1,39; on the second year the result was 1,24 and in the third 1,14. This decline in betas is due to a decrease in variability of the stock's price (which can be explained as decline in divergence of opinion).

Moreover, Miller (2000), as many other authors previously mentioned, states that firms with smaller issues are also those with greater underperformance. This is due to the fact that generally these firms are the newest and the least established. It is therefore created a situation of greater uncertainty (which may give birth to speculation) and subsequent divergence of opinion.

To conclude, the three main literature streams earlier discussed have been extensively treated during the last decades. With greater or smaller effectiveness, economists managed in some cases to explain the three different pheonomena (underpricing, "hot issue" market and long run underperformance) with the help of mathematical and statistical models. Despite the fundamental contribution of economists such as Ibbotson,

Rock, Ritter, Beatty, a comprehensive solution of these problems has yet to be built. Only through the analysis of the major different economical papers written until today it is possible to have an idea of the vastness of the problem. All the authors previously mentioned have contributed to the literature of IPOs, adopting different point of views, but in order to understand the reasons which lead to the existence of these three "anomalies" (underpricing, "hot issue" markets and long-run IPO underperformance) it is necessary to take them all in consideration.

CHAPTER III

Empirical Analysis of IPOs in the Biotech Sector

This chapter is entirely dedicated to the analysis of IPOs in a specific sector, the biotechnological one. The first chapter dealt with the more general concept of an IPO: what happens when a company goes public, why does it happen and what is the whole process which leads a private company to issue shares in the market. The second chapter instead focused on the three main literature streams that emerge when dealing with an IPO.

This third chapter is different. Instead of considering the entirety of the IPO argument, the subject will be the analysis of the IPO biotech market of the last years.

As stated earlier in the introduction, the biotechnological market has experienced a surge in the last few years. Something similar happened only 14 years ago during the so called "dot com" bubble, when the share prices of biotech firms and many more followed an increasing path until a rupture point where the financial and operative fundamentals of these companies didn't justify the value of their enterprise. This caused a huge meltdown of the industry, leading many firms to bankruptcy.

Today the situation may be different, in that many of these biotech firms are performing well, due to both a better legislative environment (the procedure which leads a drug to approval by the FDA has been improved consistently) and a better knowledge of the DNA fundamentals and therapeutic treatments. The question arising is whether these firms are going public because they want to ride the IPO wave or whether this increase in IPOs and stock returns may be justified and explained through company specific variables.

What contributes to the long run performance of these firms? Does the presence of more internally produced drugs, or financial ratios influence the returns that biotech companies will achieve in the future? The objective of this chapter is to apply an econometric

analysis with the aim of giving a better picture to the elements contributing to this "bubble" and to the surge in the companies' share prices.

3.1 Sources' Description

In this empirical study many different sources for data collection have been used. Most of the data regarding the companies' financial fundamentals, the molecules produced and the characteristics of their IPOs has been obtained through Medtrack. Other sources of data, especially with respect to share prices were Bloomberg, Osiris and YahooFinance. These have been extremely useful in obtaining the historical stock chart of the companies in the sample for the last 8 years.

MEDTRACK

Medtrack is a product of Sagient Research, a company focused on publishing specialized research and data. It is the leading business intelligence service, powering licensing, M&! activity and sales for the life science industry. Medtrack's platform offers insights into pharmaceutical pipelines, data about sales, patents and more. It has reached the amount of 34 000 companies' profiles with over 131 000 products. Medtrack works with professionals in the pharma research sector and forecasting. It delivers:

- A wide selection of datasets useful for research purposes
- A flexible interface capable of including all search data in a single view
- A customizable platform that improves and accelerates the decision-making process

It is mainly used to:

- Identify drug development partners
- Analyse research and development spending
- Screen licensing and investment opportunities

- Ensure valuations of products & technologies

OSIRIS

Osiris is the global database of Bureau Van Dijk. BVD integrates information of the main international information providers through data about major listed and unlisted companies around the world. Most of the information is detailed and of financial nature. Different templates are used to show accounts of companies according to type and location.

Examples of information revealed are:

- Company financials, reports, earning estimates, stock data
- Ratings
- SEC filings and other regulatory ones
- Business and company-related news
- Detailed information on companies' activities, M&A deals and rumors
- Directors and contacts

Through a coverage of almost 80 000 companies, Osiris helps navigating efficiently through company information.

BLOOMBERG

Bloomberg is a multinational company specialized in mass media. Founded in New York in 1981, today Bloomberg represents almost the 33% out of 16 billion dollars of the market for financial data. It connects people, investors decision makers to a network of information, data and financial news. Today Bloomberg counts almost 315 000 subscribers for its "bloomberg terminal" around the world. Mainly Bloomberg offers

software for the analysis of financial data as for example platforms for exchange and equity or news about financial companies and organizations (through its terminal, its main product). Due to its rapid growth, Bloomberg L.P launched in 1990 a new agency specialized in financial information (Bloomberg News), a television (Bloomberg Television) and many other products.

YAHOO! FINANCE

Yahoo! Finance is a web site sponsored by Yahoo!. It mainly provides financial information focusing on the U.S markets. Information ranges from stock quotes to exchange rates, corporate press releases, financial reports, message boards and many more.

According to comScore data of May 2012, Yahoo! Finance was the top financial news website in U.S with more than 37,5 million visitors each month.

Yahoo! Finance also allows users to sync with brokerage accounts, creating customized portfolios and amalgamate all the portfolios in one place. It uses a specific tracking tool, useful to monitor portfolios (especially if investors control more than one).

3.2 IPO Sample and Dataset Description

The IPO deals in the biotech industry were selected from Medtrack and ordered according to the date of completion. However from an initial sample of 107 IPOs, a selection procedure led to a complete sample of 55 IPOs of biotechnological companies.

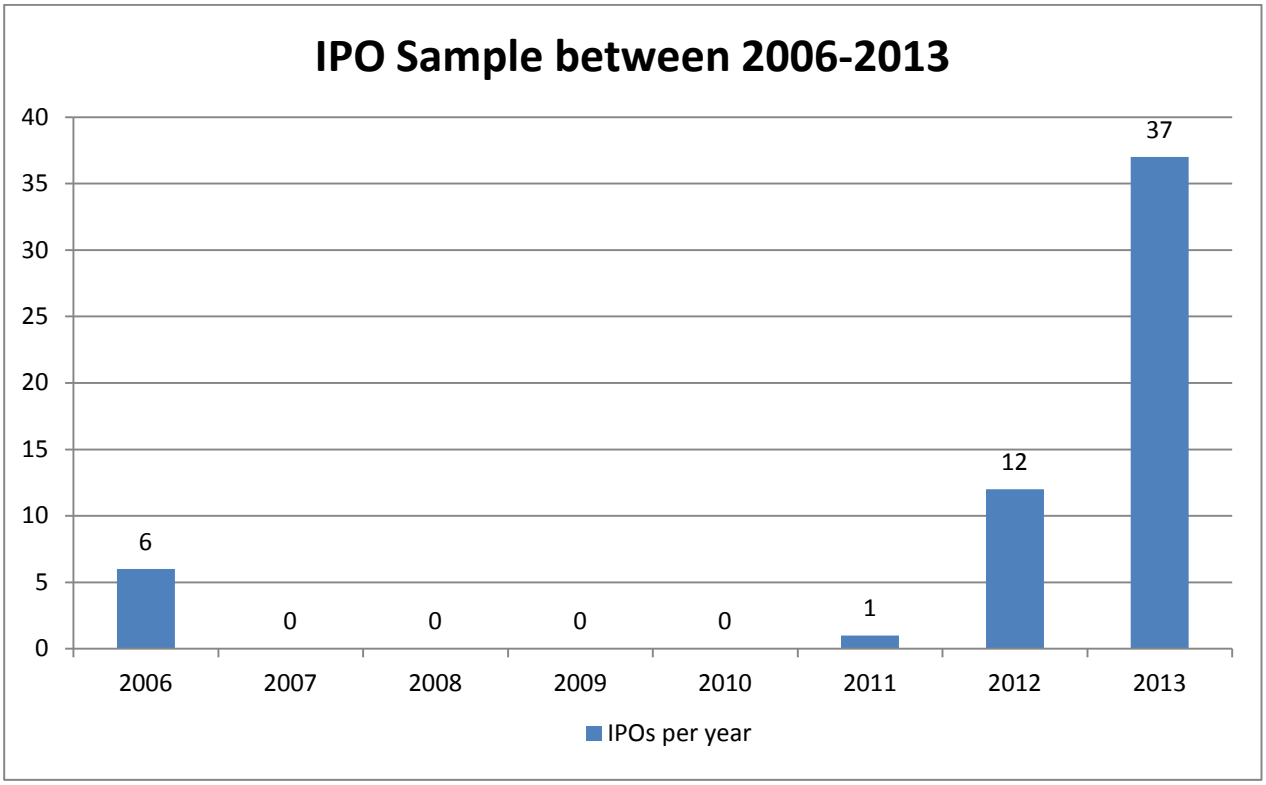
The selection procedure eliminated the following deals:

- 21 IPO filings (companies still waiting for the SEC approval and who still haven't gone public)

- 7 IPO postponements (companies which have decided to postpone the IPO date, probably due to adverse market conditions or internal companies' problems)
- 1 IPO withdrawn (the IPO filing has been completely withdrawn and the IPO will not be carried out)
- 23 IPOs were eliminated from the sample due to a lack of relevant information

The result is a sample of 55 IPOs completed in a time ranging from 2006 to 2013. It is possible to see below a histogram (Figure 5) representing the number of IPOs of the sample according to different years of completion.

Figure 5 – A historical representation of the IPOs in the sample



The striking aspect, is that most of the IPOs are concentrated in the last two years, namely 2012 and 2013. This is a confirmation of the fact that the biotech IPO boom started just two years ago and the trend is likely to continue for both 2014 and 2015. It is therefore not a surprise that the biotech IPO surge has attracted the attention of part of the financial media.

3.3 Variables

The variables used in the econometric model are 8. While some are more specific to financial aspects of the companies, others are related to the strategic and operational side. Below are described all the different variables with the names which will be found also in the linear regression later through the pages.

LONG RUN PERFORMANCE:

This variable describes the long run performance of the biotech companies in the sample. It is a ratio, namely the percentage return of the firms, calculated dividing the IPO price per share at date 31/06/14 minus the IPO price per share, by the same IPO price per share. Or through the simple formula:

$$r = \frac{(P_f - P_i)}{Pi}$$

Where "r" stands for return, and "P" stands for price (either final or initial).

UNDERPRICING:

This variables describes a very important aspect regarding the IPO subject matter in general. In this case, the IPO underpricing is calculated by simply dividing the IPO price of the day after the first trading day by the IPO price per share and then subtracting one. It simply calculates the percentage increase in the stock price from the initial stated one and the price at the end of the second trading day.

The formula adopted is the following: $Underpricing = \frac{(P_{1^\circ\, day} - P_{book})}{P_{book}}$

COUNTRY:

This is a dummy variable representing the origin of the different companies in the sample. It may have values 0, 1 or 2: If 0 the firm is European, if 1 it is American (U.S) if it's 2 then it's Asian.

PORTFOLIO STRATEGY:

This variables captures the amount of drugs originated internally to the firm with respect to the total drugs in the company's portfolio. Mainly drugs may be originated, licensed or acquired (also through M&As). The values are obtained dividing the originated drugs by the sum of all these components (originated, licensed and acquired).

RISK CLASS:

This variable indicates the level of risk associated with each firm. In order to do so, the companies have been divided in six categories (ranging from 1 to 6). The level of risk is assessed according to the amount of molecules developed and their phase. Infact, there are mainly 6 phases in the development of a specific molecule: preclinical, phase I, phase II, Phase III, approval pending and the marketing of the molecule (which has then become a drug). The level of risk associated to each of these six steps is decreasing: the most risky phase is the research phase, while the less risky is the marketing phase.

REVENUES:

This variable indicates the amount of revenues generated by each firm. This is the first of the variables regarding financial information of the companies.

PROFIT GROWTH:

This value represent the operating profit growth of the biotech companies and it is expressed in percentage terms. The greater the value, the larger the profit growth of the firm.

ROE:

This variable represents the return on equity for each company. The formula used to calculate it is obtained dividing net income by shareholder's equity. Return on equity measures a corporation's profitability revealing how much profit the firm generates with the money invested by shareholders.

N_EMPLOYEES:

The variable indicates the number of employees present in each of the firms in the sample. It represents discrete values so the higher they are, the larger the employee pool the company disposes of.

Below is reported a table (Table 10) representing the most important descriptive statistics regarding each of the variables: the minimum value, the maximum value and the average.

Table 10 – Descriptive statistics

Variable	Min	Max	Mean
Long run performance	-95.52%	1 119.742%	70.9632%
Underpricing	-42.455%	38.4494%	-6.765%
Country	0	2	0.981481
Portfolio Strategy	0	1	0.633866
Risk Class	1	6	5.039216
Roe	-197.01%	845.64%	1.78%
Revenues	0	1 200 000 000	41 938 415.69
Profit Growth	-12 292.42%	197.97%	-213.10%
N. employees	0	28000	574

3.4 Econometric Model

The econometric model used to describe the variables adopts the ordinary least squares method (OLS). The OLS method is used to estimate the unknown parameters in a linear regression model.

The econometric model formula is the following:

$$Y = ß_0 + ß_1 x_1 + ß_2 x_2 + \ldots + ß_k x_k + e$$

Here $ß_0, ß_1 \ldots ß_k$ are the regression parameters while e is an error random variable with a mean value equal to 0.

The regressors used in this case are multiple, namely 8, one for each variable described earlier. The dependent variable (Y) is represented by the long run performance variable.

Therefore the model becomes:

$$L.R.Performance = ß_0 + ß_1 underpricing + ß_2\ country + ß_3\ portf\_strategy + ß_4\ risk\_class + ß_5 revenues + ß_6\ operating\_growth + ß_7\ ROE + ß_8\ employee\_count + e$$

The idea behind the multiple regression model is that it allows estimating the effect on the dependent variable (Y) of changing one variable (underpricing for example) while holding the other regressors constant.

In the next page is shown the table (Table 11) obtained through the regression on STATA, an advanced statistical software package, generally used for research purposes especially in the field of economics.

Table 11 – OLS estimation

Source	SS	df	MS
Model	32.1807431	8	4.02259289
Residual	91.0767978	17	5.35745869
Total	123.257541	25	4.93030164

Number of obs	26
F(8, 17)	0.75
Prob > F	0.6483
R-squared	0.2611
Adj R-squared	-0.0866
Root MSE	2.3146

LRPerformance	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Underpricing	-2.415123	2.905417	-0.83	0.417	-8.545016	3.714771
Country	2.868911	2.290354	1.25	0.227	-1.963314	7.701136
PortfolioStrategy	-4.552566	2.57087	-1.77	0.095	-9.976628	.8714959
RiskClass	.8083202	.5876609	1.38	0.187	-.4315359	2.048176
N_employees	.000975	.0007874	1.24	0.232	-.0006864	.0026363
Revenues	-2.49e-08	1.85e-08	-1.35	0.195	-6.39e-08	1.41e-08
Profitgrowth	.0230571	.0246146	0.94	0.362	-.0288752	.0749894
ROE	.336354	.2933855	1.15	0.267	-.2826354	.9553434
_cons	-2.351288	4.484448	-0.52	0.607	-11.81265	7.11007

3.5 Analysis of empirical evidence

The first step is to set the possible expectations for the regression results. The aim of the linear regression is that of understanding which factors may influence the long run performance of biotech companies. Are the strategic elements more relevant than the financial ones or vice versa?

One problem that has arisen during the analysis of the sample is its small magnitude. Unfortunately a sample of 55 IPOs doesn't help the regression analysis especially in terms of significance. The significance of the regressors is generally seen using the t-statistic values or the p-values. The adoption of either doesn't imply any difference in the empirical results, but is just an alternative way of commenting on the regression results.

The lack of a greater sample will therefore lead to a difficult analysis regarding the p-values which will certainly be high, but some empirical results can nevertheless be given by observing the sign of the coefficients.

Starting from the first variable, underpricing, it is immediately possible to make some observations. On one side it must be noted that the magnitude of the p-value means that the coefficient is not significant at any reasonable level. However, as stated earlier it must be considered as a determinant factor the small dimensions of the sample.

Independently from the significance of the coefficient, its sign is negative. This should go in favour of the economic intuition that a higher level of underpricing will lead to a smaller long term performance.

This result is in line with the major findings of most economists of the last 30 years. Infact, a greater underpricing is generally associated with greater uncertainty. As written in the previous chapters, underpricing is often conceived as a tool either to signal investors of the soundness of the firm, or also to reward (as in Rock's model) those investors (mainly free riders) who decided to invest in the IPO, despite the asymmetric information usually present in these cases.

Months after the IPO, the so called "divergence of opinion" which has characterised investors in the days prior to the IPO, will tend to decrease. The building of a firm's operational and financial history leads the various investors to have a same idea about the value of the company.

This means that those investors (optimistic) who first believed the value of the newly issued shares to be high, will adjust their expectations, leading the share value of the firm to decrease. This is the main idea behind the negative value of the underpricing coefficient.

The country variable has instead a positive sign. This result is however of little relevance for two different reasons: the first is the lack of significance of the variable (also at 10% significance level), the second is that the dummy variable used, as explained earlier, may show 3 different values, zero, one and two.

The main problem is that in the sample of 55 biotech firms, most of them are U.S based companies (more than 45 companies). This means that the empirical result represented both by the magnitude and by the sign of the coefficient is not relevant

The coefficient regarding the portfolio strategy variable is the only significant one at a 10% significance level. The p-value is infact 0.095 with a t-statistic of -1.77. More specifically, 1.77 is greater than 1.645, the value corresponding to a 10% significance level when considering the t-statistic table.

The sign of the variable is negative, which may be a surprising result at first sight. As stated earlier, the variable represents the amount of originated drugs a firm has in its portfolio, out of all the drugs present (originated, licensed or acquired). One could think that the major presence of originated drugs should have a positive effect on the long run performance of a biotech firm, and therefore the negative sign related to the coefficient may come as a surprise.

The economic insight behind the negative sign may however be explained by the level of risk. It is known that the biotech industry is considered a very risky sector. Firms must encounter sunk costs, strict legislative procedures from the FDA and must also account for some cases where drugs are discovered to be ineffective. All these factors contribute to increasing the risk associated with the biotech industry.

The higher presence of drugs originated internally may contribute to increasing the risk level of the companies. Infact, for drugs acquired externally it would be reasonable to associate a smaller risk, due to the fact that these firms are less dependent form internal activities, having the chance to develop their portfolio by capturing eventual investment opportunities which may improve the quality of their portfolio.

The variable representing the level of risk shows surprising results. The sign related to the coefficient is positive, which would mean that a higher level of risk of the firm has a positive effect on the long term performance. This result goes against the common view that a higher level of risk is associated to smaller long term returns, even because usually a larger risk is associated with greater underpricing, element which has been proved to contribute negatively to future share returns.

It is not surprising then that the coefficient is not significant at any reasonable level.

The variable concerning employee count shows a positive coefficient, indicating a positive relationship with respect to the dependent variable. The rationale behind this is that a firm with a greater number of employees is also a more established firm. Economists have already shown that more established firms (both in terms of years from foundation and in terms of profit generated) tend to show a more steady increasing performance than small, newly founded companies.

Despite this logical reasoning, the coefficient is not significant at 10%, making it econometrically speaking difficult to interpret.

The two financial variables, ROE and operating profit growth, despite not being significant statistically, do show a positive relationship with respect to long run performance.

This is an expected result. It would be strange for a company to negatively influence future performance when increasing its ROE or its profit growth. A financially stronger company will assure better future performance than a firm characterised by small growth or returns. Therefore it is no surprise that the values show a positive sign.

The R-squared deserves a final commentary: the value displayed in the table is rather small (0,2611). The R-squared is the fraction of the sample variance of (Yi) “explained” by the regressors. This value ranges from 0 to 1, and a result close to 1 indicates that the regressors are good at predicting Yi (the values of the dataset). More generally, the coefficient of determination (R-squared) indicates how well the data fits the statistical model.

The result obtained in the linear regression would indicate that the variables disposed don’t contribute to the “goodness of fit” of the model, and that the regression line doesn’t effectively approximate the real data points.

A final note should be given with respect to the sample dimensions. The small number of observations (55) and in some cases the lack of information regarding some of the variables used earlier, have surely influenced the results of the regression.

CONCLUSIONS

The objectives of the thesis were mainly two: to give a picture of the characteristics of an IPO and its economics, and to explain on the other side the specific case of IPOs in the biotech sector.

Therefore it is possible to distinguish between two different branches of the thesis, one regarding IPOs in general, especially considering their theoretical aspects, and another one dealing instead with a precise matter that is actual today: the biotech IPO boom.

In the first chapter the discussion was focused on the mechanics of an IPO. First I pointed out the different ways companies follow when searching for funds in the market. Some prefer adopting private funds, or move towards financial loans. Others instead prefer to raise funds through public investors in the forms of IPOs or SEOs. Very often the first is followed by the second, in that the firms going public have sometimes already planned a following secondary offering in the near future. A branch of IPO literature also give credit to the idea that the IPO underpricing is voluntarily perpetrated by companies, with the aim of recovering from losses in subsequent SEOs, and so that all these facts are accounted for from the start.

Then the precise economics of an IPO are described. What are the different steps a firm must undertake before opening its shares to public sale? The procedure is rich of interesting facts, some specific to the country in which the company desires to be public. For example there are different ways through which the investment bank (underwriter) assesses the price per share and allocates the stocks, namely through bookbuilding or through an auction system. This is a decision that competes to just the underwriter and the firm.

The second chapter follows a different path. Looking back to the history of economic literature, I selected three famous topics in the economics of an IPO: the underpricing, the “hot issue” market and the long run underperformance. These problems have puzzled economists for decades, even because it is possible to see them still in IPOs today. They are an actual reality which firms going public must face.

The curious aspects of these three events, is that it is not completely clear yet who gains from them (if anyone does), what causes their existence, and whether they are voluntary or just a product of market movements.

Economists such as Rock, Ibbotson, Ritter and Beatty have exposed their theories, which I discussed further in the chapter. There is no common accepted solution and this is due to the fact that empirical work never ceases to evolve. Today the world is flowing with data, and it wouldn't be surprising if some new empirical research went against previous work considered to be solid.

In the third chapter the second purpose of the thesis is taken in consideration. Today the biotech industry is experiencing a surge of historical importance, something that happened only one time before. And it bore consequences: the dot-com bubble exposed many biotech companies to bankruptcy, and their values crashed to historical lows. Is it possible to experience the same event in the near future?

Another question that pushed me towards an analysis of this reality regards the determinants of the performance of these biotech firms. The rationale is that by understanding what contributes to future performance it is possible to understand whether the recent economic surge in the industry may be justifiable or not. In the latter case the risk of another bubble creation and explosion is not so remote.

Unfortunately the sample taken in consideration poses a difficult task to complete. The poor significance of some of the variables considered makes it difficult if not impossible to give a definite answer (although econometrics as a whole never gives a definite answer) and just the analysis of the sign of some coefficients may contribute to the purpose of the model.

The only certainty that is possible to extract, is that this empirical analysis strongly relies on new data. During 2014 and possibly 2015 many more companies belonging to the biotechnological sector will decide to go public, and this gives economists and researchers the chance to perform a more thorough analysis with the aid of better and more robust econometric tools.

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