Stéphane Holmière 1101978 Department of Economics

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"*Analyse the problem of the underpricing of Initial Public Offerings of stocks*"

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An analysis of the underpricing of Initial Public Offerings of stocks

Abstract

The purpose of this study is to provide empirical evidence for the phenomenon of underpricing of Initial Public Offerings. On the basis of sample IPOs from the NYSE and NASDAQ exchanges, the underpricing of stock IPOs is found to still be prevalent after the information technology bubble petered out in the early 21th century. A model has been developed to analyse the accuracy of a number of theories put forward to explain this underpricing, some which have not been the object of a comprehensive investigation, yet. The results indicate that underpricing can in part be explained by informational asymmetry between the underwriters, issuing firms and investors. Furthermore, IPO underpricing is found to exhibit mild cyclicality and seasonality, and variations across economic sectors. Finally this study finds that underpricing of IPOs is more severe on the NASDAQ than on the NYSE, and then examines the variations in underpricing across these two stock exchanges.

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1 INTRODUCTION

For a privately held company to become publically traded it has to undergo an Initial Public Offering. Through this process a firm makes its capital available for purchase to a select group of investors in the primary market. This process is usually facilitated by the companies hiring a syndicate of investment banks which prices and sells the equity to investors. Once these shares start trading in the secondary market, prices can freely adjust[1].

The issue that has been of great concern to economists and professionals for decades is that the the prices of newly issued stocks soar on the secondary market. Statistics compiled by Loughran and Ritter (2004), for instance, show that yearly mean first-day IPOs returns between 1980 and 1998 varies from 3.6% to 22.2%. Initial returns of this magnitude deviate from the predicted Capital Asset Pricing Model return[2] and thus imply that IPOs on average are underpriced. Past research has offered different explanations to this underpricing phenomenon, a large number of these theories will be presented. This paper will then focus on a few of these key elements, and using an empirical model, the hypotheses proposed by other authors will be tested. The analysis will also examine some of the new or less discussed findings relating to IPO underpricing. Generally, the results presented in this analysis will be in accordance with past research: the proposed empirical model show clear signs of underpricing of IPOs on both the NYSE and NASDAQ exchanges in the United States between 2000 and 2013.

2 OBJECTIVES AND FOCUS

The presented analysis will assume that in the IPO market, the prospective investors are the party at an informational disadvantage. The investors' expectations and behaviour under uncertainty have not been modelled. However, the presented model integrates certain variables which could influence the level of ex-ante uncertainty about an IPO, which is defined as: the uncertainty regarding valuation of a company and subsequently the fair price of its shares due to a lack of available information. Factors that have been hypothesised to be a signal of quality to investors include: the offer price of the IPO,

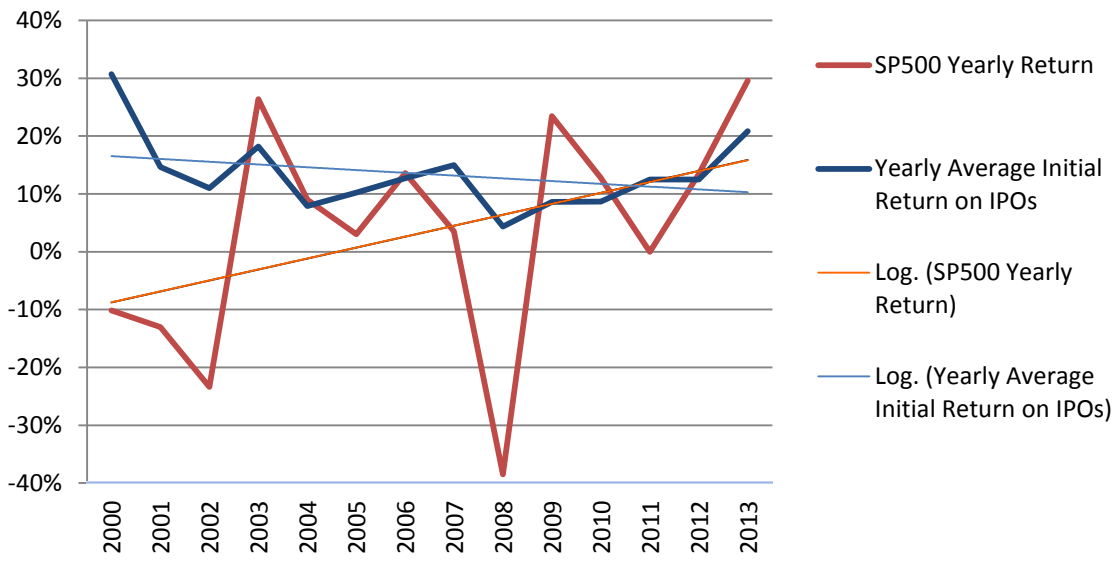
[1] Supply of shares is relatively inelastic. During the IPO lock-up period, company insiders can be prohibited from selling their shares either through a private agreement or government regulation: see the U.S Securities and Exchange Commission's website for details.

[2] See for instance Kaya (2012) for calculations regarding deviations from CAPM predicted return.

the market capitalization and age of the company, but also the number of shares offered in the IPO in proportion to the total number of shares outstanding. The conclusion that firms offering a smaller relative number of shares in their IPO underprice to leave a "good taste in investors mouths" as coined by Ibbotson (1975) - rests on the assumption that these firms are more likely to issue future Seasoned Equity Offerings. Furthermore, reputable underwriters are shown to decrease underpricing, though the evidence is weak.

A number of analysis such as Loughran and Ritter (2004), have focused on the variation of IPO underpricing over time. However, as the chosen IPO sample only covers 13 years, this analysis will not specifically see how the underpricing phenomenon has evolved over these years. Graph 1 below illustrates that the initial return on the sample IPOS shows no clear trend over the 13 last years, albeit a slightly negative logarithmic one, especially when compared to the yearly return variation of the S&P 500 index.

Graph 1: Average initial return on sample IPOs



This analysis finds no conclusive evidence towards the behaviour of short-run IPO returns in relation to the market cycle, although the results indicate a slight negative correlation, contrary to the hypothesis that will be proposed. On the other hand evidence supporting the existence of hot issue markets, first hypothesised by Ibbotson and Jaffe (1975), is presented: large IPO volumes seem to increase underpricing. This effect is relatively weak however, possibly due to the fact that the hot issue markets during the 1980s and late 1990s were larger in terms of IPO volumes.

A possible stock market anomaly, suggested by authors such as Rozeff and Kinney (1976), is the seasonality of stock returns. There is little past research on the subject of seasonality specifically relating to IPOs. However, studies by Dolvin and Pyles (2007) and Kliger et al. (2012) propose theories linking the weather and the seasons to the average investors' mood which in turn influences the initial return on IPOs. While this theory has been used as inspiration to examine seasonality in IPO underpricing, no attempt will be made to replicate these results as they these studies' focus are on behavioural economics. Seasonality has been integrated into the model in an effort to see if there is a 'January effect' and a 'September effect' on underpricing. The September effect is found to be a significant determinant of underpricing. Interestingly, both months have a positive effect on initial returns on IPOs, while they are supposed to have an inverse effect on stock returns.

Ex-post uncertainty is the uncertainty related to an IPO's price-performance in the aftermarket. It has been included the model by looking for an effect on underpricing following the company's listing-choice. One of the key differences between the NYSE and the NASDAQ exchanges is that the first is an auction market whereas the second is a dealer's market. In accordance with Bennouri et al. (2011), this paper finds that IPOs on the NASDAQ show greater signs of underpricing than those on the NYSE. The issue of underpricing across exchanges has been further developed to test whether NASDAQ-listed IT companies in particular are more underpriced. What might seem peculiar at first is that these companies are found to be less underpriced than their NYSE-listed equivalent. Our explanation for this is that the NASDAQ exchange has historically been tech-heavy, and investors on the NYSE will want to be compensated for the perceived risk associated with IT companies for instance. Indeed underpricing is found to also vary with the different industrial sectors, Gregoriou (2005) finds that firms belonging to new and emerging industries exhibit greater initial returns on their IPOs, this analysis finds evidence that supports this: IT sector IPOs are the most severely underpriced. Furthermore evidence will be presented that the consumer services sector's IPOs also experience high levels of initial return, in accordance with Ali et al. (2010) findings, although the two aforementioned studies focused on the German and Bangladeshi IPO markets, respectively. Based on the above findings we formulate a hypothesis stating that the determinants of IPO underpricing change depending on the companies' listing decision. Whether this is due to differences in investor psychology or company characteristics will have to be the subject of another study.

3 PAST RESEARCH

3.1 IPOs and price uncertainty

The price of a security should reflect its demand and supply, underwriters have to determine the fair value of a company and price it accordingly. When the market's valuation of a security is unclear, there is ex-ante uncertainty and it becomes harder to set the price of an IPO. Beatty and Ritter (1986) predict that the greater this uncertainty is, the greater the expected underpricing of IPOs: cheaper shares act as a risk premium to the investors, to compensate for the lack of information available to them. The authors use two proxies for ex-ante uncertainty: the perceived speculative nature of the investment and the gross proceeds of the businesses, to test for its effect on IPO prices, for all companies going public in the United States between 1977 and 1982. Their results suggest that there is a positive relationship between the ex-ante level of uncertainty and short-term rate of return on IPO shares.

If there is a negative relationship between the level of proceeds for a company going public and its level of initial return, this implies that smaller companies' IPOs are on average more underpriced, assuming of course that larger companies generate higher proceeds. This is supported by Lowry et al. (2010) who find that in periods when a larger proportion of companies going public are small, there is a larger level of excess initial return in the market for IPOs. The same analysis also applies to "young" companies as shown by Loughran, et al. (1994).

Interestingly, Koop and Li (2001) find, using a large sample of shares over a long period of time that IPOs tend to show greater underpricing than Seasoned Equity Offerings (SEOs). Their findings are consistent with Smith's (1977) analysis of the underpricing of SEOs. The uncertainty of returns seems to be greater for assets which have not been publicly traded before, i.e. for which there is less public information available. These authors' results on the performance of SEOs could of course also be interpreted as evidence that firms underprice IPOs to "leave a good taste in investors' mouths".

3.2Oversubscription and underpricing

Oversubscription occurs when demand for an IPO exceeds supply, which is fixed; at a specific price, investors have placed more buy-orders than the underwriter can fill.

Chowdhry and Sherman (1996) find when underwriters that set and reveal the offer price of an IPO, several weeks or months before the offering is made, the probability that the offer will be underpriced is great. After the price of the issue is set, investors will gather information about the prospects of the company. During this time period, there is thus a possibility of negative information about the

company leaking, causing the issue to fail if investors consider the company overvalued. By underpricing, the underwriters “hedge” against a possible failure of the IPO, and thus leave money on the table for the issuing firm. Having had time to research the company, investors realize that the issue is underpriced and rush to secure as many shares as possible. The issue then becomes greatly oversubscribed. This is supported by evidence provided by Loughran et al. (1994) who find that the average level of underpricing in IPOs is greater in countries where the IPO price is set in advance, controlling for the fact that the average number of firms going public under this pricing regime are older.

Koh and Walter (1989) find that for Singaporean IPOs going public between 1973 and 1987, which use the same offering contracts as European IPOs, the shares were oversubscribed 40 times. They conclude that there is a very strong correlation between level of oversubscription and excess initial IPO returns.

3.3 Investor profiles and asymmetric information

If IPOs show evidence of oversubscription, all investors will not receive shares, or they will receive fewer shares than they ordered. Rock (1986) developed a model in which investors are split into groups of "informed" and "uninformed" investors according to the level of research, which comes at a price, which they have undertaken. Informed investors know, to some extent, the fair value of the company. Uninformed investors, on the other hand, believe they take on additional risk when buying into an IPO as the perceived volatility of their investment is greater.

Beatty and Ritter (1986) build on this model, showing that uninformed investors have greater ex-ante uncertainty than informed investors. For the underwriter however, there is a risk that the IPO might fail, if it does not attract enough funding. The underwriter therefore lowers the price to attract uninformed investors as well. In this model, there is rationing, the informed investors will buy the "best" IPOs, and the uninformed will be facing a "winner's curse" problem. The uninformed can only hope to break-even on average: as the probability of being allocated shares increases, so does the probability of these shares being those of an underperforming company.

However, the theory that rationing in IPOs only affects uninformed investors is contradicted by Parlan and Rajan (2005), they find that only about half of, what they deem to be, informed investors actually get allocated shares. Contrary to Rock's (1986) model, the authors propose a model where informed investors are rationed: since informed investors are likely to have a higher valuation of good assets, they would bid high to get allocated more shares. The winner's curse problem here is that the investors who get allocated the shares have a higher valuation of the asset than the rest of the market. Since

these investors are informed, they are aware of the winner's curse problem and will limit their bids, which results in underpricing.

3.4 Underwriter incentives

Investment banks face the possibility that the IPO might fail if they do not underprice enough. On the other hand, if the banker leaves too much "money on the table", the issuing firm has foregone an opportunity to raise more funds.

Beatty and Ritter (1986) find that for 49 underwriters in the US, underwriters that consistently misprice their securities lose market share in favour of their competitors. They suggest that the market mechanism in the financial industry provides incentives for the underwriters to underprice, while still providing the firm going public with a satisfying level of funding. This is consistent with Lowry et al.' (2010) findings that IPOs are more accurately priced by underwriters that are perceived to be of high quality, providing that there is no substantial asset bubble in the market.

Under certain regimes, where investors are required to pay in advance for assets they might not receive, underwriters could profit from oversubscription while underpricing IPOs even further. In their analysis of the different IPO markets, Chowdhry and Sherman (1996) show that if oversubscription occurs, investment banks will be able to use the excess funds given to them to earn an interest float which they keep after reimbursing the investors, this might create a conflict of interests.

As previously discussed Rock's (1986) and Chowdhry and Sherman's (1996) models, among others, assumes that there exists groups of investors that are more informed about the IPO than the other market players, including the issuing firm itself. However, there are other theories of asymmetric information. Baron (1982) argues that underpricing occurs when the underwriters are in possession of more information about the market that the issuing firm.Underpricing is therefore the result of either: companies being unable to control the amount of effort exerted by their underwriters, or, having to compensate these underwriters for the use of their information, depending on the contract arrangements.

3.5 Issuers' interests: signalling and control

Some suggest that the issuing firms are the party with the informational advantage. Ibbotson (1975) state that if a company knows its prospects are good, it can underprice and still receive good funding in the long-run. According to the author strong firms underprice to leave "a good taste in investors mouths": if investors experience great returns on their investment in an IPO, there is a higher chance

that they will participate in a seasoned offering. Similarly, in Allen and Faulhaber's (1989) model the company knows its prospects better than the investment bank which simply facilitates the issue of shares. By underpricing in such a way that it will be unfavourable for bad firms to do the same, the good firms provide potential investors with a signal of its relative strength, separating themselves from the bad firms.

Another reason a company might want to underprice its first issue, is that management sees disperse share ownership as a way of maintaining control over the business. Brennan and Franks (1997) find, for a sample of British IPOs, that the oversubscription which occurs when the asset is seen as underpriced, will favour smaller investors. The resulting disperse ownership of shares makes hostile takeovers implausible. This could partially explain Parlan and Rajan's (2005) findings that informed investors also suffer from rationing, assuming that large institutional investors are usually among the informed. However Loughran et al. (1994) argue that in US-type a book-building process, the underwriters will favour large repeat-business investors, in contrast to the issuing firms' preferences. Pritsker (2006) state that, if large institutional investors are preferred by the issuers, they will have the opportunity to buy a substantial amount of the shares offered in the IPO. This effectively reduces aftermarket liquidity. Small companies will, according to Loughran, Ritter et al. (1994), prefer to market themselves to smaller investors by offering a low price, because these investors will not move the market when they trade. Similarly, Lowry et al. (2010) report that underpricing tends to be greater for smaller offerings and companies, making it more likely that smaller investors can participate in the IPOs.

3.6 Business cycles and seasonality

If there is a large demand for the shares offered in an IPO once the securities start trading in the aftermarket, generating a large price increase, this IPO will be dubbed a "hot issue". A substantial amount of "hot issues" going public in the same time period constitutes a "hot issue market". Ibbotson and Jaffe (1975) found that for the IPOs in the US between 1960 and 1970 there was evidence of seasonality in the returns, similarly to the "calendar effect" market anomaly that affects stock prices. While the authors did not find evidence that market return directly increases underpricing, others have indicated that underpricing is cyclical. These include Loughran and Ritter (2004) and Loughran et al. (1994), and Lowry et al. (2010) who propose that hot issue markets follow the bull and bear pattern of the financial markets.

Seasonality in stock returns is well-known market anomaly. Studies, like that of Ariel (1987), find evidence in support of the ‘January effect’ for instance, though the evidence is at times weak and criticised by proponents of the efficient market hypothesis. The effect of seasonality on IPO return

specifically has not been widely discussed. However a recent study by Jones and Ligon (2009) finds that IPO returns exhibit a ‘monday effect’ similarly to stock returns. Furthermore Dolvin and Pyles (2007) and Kliger et al. (2012) report that IPO underpricing is higher during months when investors are likely to be influenced by seasonal affective disorder, i.e. by the lack of sunlight.

For the information technology bubble of the late 1990s, Lowry et al. (2010) find a strong correlation between the return and volatility of an IPO and its underwriter's "ranking score". They suggest that the underwriter's wish to generate "analyst coverage" of an IPO, i.e its marketing, seems to triumph the need for accurate pricing. Similarly Loughran and Ritter (2004) find that the most successful underwriters were behind some of the more severe underpricing during the internet bubble. As underwriters represent both sides of the market, their most profitable strategy could be to align themselves with whoever holds the informational advantage at the time: during bubbles, it is likely that this would be the issuing company.

3.7 Regulatory regimes and legal matters

A study by Ruud (1993) finds that parts of excess initial IPO returns can be explained by the investment banks providing price support for the issues. Price support can occur through for instance, ‘stabilizing bids’ or the exercise of ‘greenshoe’ options. The author argues that this is allowed by the American authorities as a way to counter dramatic falls in share prices as IPOs enter the aftermarket.

In other systems, government regulation, and not the lack thereof, is seen as a direct source of underpricing: Chowdhry and Sherman (1996) describe former government interference in Asian markets to set price ceilings on IPOs.

Underpricing can be a distortion created by the tax system, as described by Loughran et al. (1994) find that, in Sweden, IPOs are possibly underpriced because of the distortion created by differences between capital gains and income tax rates: if the first rate is relatively low compared to the second, compensation in shares might be preferred to a salary bonus if the offer price of the shares is low enough.

Tiniç (1988) proposes that by underpricing, investment banks and issuing firms can avoid lawsuits should the value of the IPO drop significantly in the aftermarket. IPOs after the establishment of the Securities and Exchange Commission show greater excess initial returns. This is taken as evidence supporting the lawsuit avoidance model: since the SEC’s inception, it has become much easier for investors to sue financial institutions. However, Loughran et al. (1994) state that if the threat of legal action is a significant determinant of underpricing, one should be able to observe, holding everything else constant, greater underpricing in the US because of the country's legal culture, and according to their research there is no evidence of this.

3.8 Sectors and market structure

In the aggregate IPOs seem to be underpriced, but the severity of the underpricing varies with the sector in which the issuing firm operates. According to Gregoriou (2005), 'new economy' firms' including IT, media and health care IPOs are the most volatile: indicating both large degrees of underpricing and overpricing. This could be due to the fact that firms operations in these sectors are often young growth companies. Also, companies with little in terms of tangible assets could have to offer a larger return on equity to appeal to investors; large initial returns would thus be required for 'new economy' companies to attract funding. This could explain why companies operating in the consumer services sector are underpriced when they go public, as documented by Ali et al. (2010): they rely on human capital.

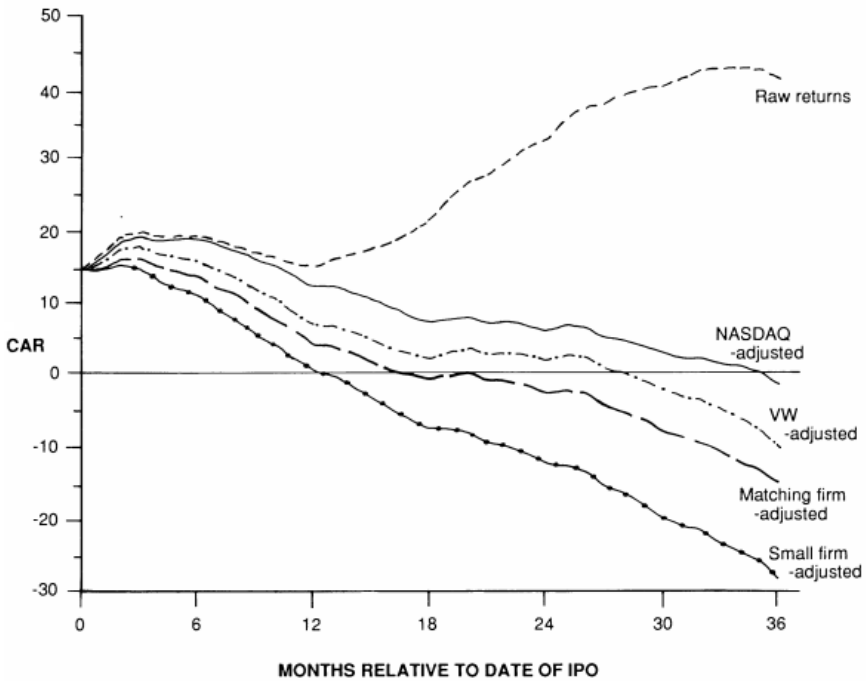
A study by Corwin and Harris (2001) finds that growth companies and riskier firms are more likely to be listed on the NASDAQ than the NYSE, although the authors do not establish a link between a company's choice of exchange and the expected underpricing of its IPO. However, Bennouri et al (2011) find that NASDAQ IPOs are generally more underpriced than their NYSE counterparts. The authors attribute the underpricing differentials to the different structure of the two exchanges: the system used by the NASDAQ increases ex-post uncertainty of the value of the IPO in the secondary market because the bid-ask spreads on the NASDAQ are much higher than those on the NYSE.

4 MODEL BACKGROUND

4.1 Defining underpricing

This paper's focus is on the underpricing of IPOs. On the other hand, part of the IPO performance puzzle is that while IPOs are expected to offer the possibility of large short term returns, they have been found, by for instance Ritter (1991), to underperform the market in the long-run. The consequent short term underpricing and long run overpricing of IPOs is depicted in graph 2, on the next page.

Graph 2: The Long-Run Performance of Initial Public Offerings[3]



Source: Ritter (1991)

To determine whether an IPO has been underpriced, the following analysis will only take into account its first day returns on the secondary market, though severe underpricing is likely to yield high returns on the IPO for several months, as shown in Graph 1. Determining the short term underpricing of an IPO requires a benchmark: calculating the S&P 500 daily return[4] for the period 2000 to 2013 shows an average daily return of less than a thousand of a percent. This measure only serves to put the level of mispricing/underpricing in context, as a 'risk-free' rate and the Betas of the sample IPOs would be required to calculate the predicted CAPM return. Furthermore, restrictions on short selling and selling due to lock up periods on IPO shares would violate the CAPM assumptions outlined by Fama and French (2004). However, studies by for instance Edwards and Hanley (2010) show that the short-selling of IPOs is common. Consequently, no further comments will be made on the validity of established asset pricing theories. The described daily market return is so low that the analysis will treats any IPO that exhibits a price increase on its first day of trading as underpriced.

The level of underpricing of an IPO has been calculated as the percentage change between its offer price (P_0) and its closing price on the first day of trading (P_1). The price change has been multiplied

[3] CAR: Cumulative Average Return.
[4] Based on data provided by the Federal Reserve Bank of St. Louis, available at: http://research.stlouisfed.org/ The S&P 500 has been chosen because it covers both the NYSE and the NASDAQ.

by 100 to give a better visual representation of the impact the different variables have on underpricing in terms of percentage points.

$$Mispricing = \frac{P_1 - P_0}{P_0} \times 100$$

4.2 Hypotheses

Based on the theories presented in the literature review, a number of hypotheses concerning the initial returns on IPOs have been formulated:

Underpricing: There is evidence of underpricing in the IPOs launched on the NYSE and NASDAQ between 2000 and 2013.

Asymmetric information and ex-ante uncertainty: The more reputable the underwriter, the less underpriced are the IPOs it underwrites. There is a negative relationship between both the size and age of a company, and the expected underpricing of its IPO. Similarly, setting a higher offer price reduces the underpricing of the IPO. Finally, there is a negative relationship between the number of shares offered in the IPO to outstanding, and underpricing.

Cyclicality and seasonality: The level of underpricing in IPOs varies with the business cycle; when aggregate stock prices are rising so does the initial returns, and thus the underpricing, of IPOs. There is a postitive relationship between the number of IPOs and their level of underpricing, i.e. hot issue markets exist. Similarly to stock returns, IPOs are subject to monthly seasonality; January has a positive effect on underpricing whereas September has a negative effect.

Sectors and exchanges: Underpricing varies across economics sectors. It is more severe for the IT and consumer services sectors, whereas financial and energy sector IPOs are less underpriced. NASDAQ listed IPOs are more underpriced than those on the NYSE. There is an added positive effect on underpricing for NASDAQ listed IT companies.

5 EMPIRICAL MODEL

5.1 Sample description

In order to analyse the NYSE and NASDAQ IPO markets, a pooled cross-section of 782 companies going public in the US between January 2000 and December 2013 has been used. This paper assumes that the companies are listed on the same exchange at the time of writing, as they were when they went public. Some companies have been delisted: DynaVox Inc. for instance, was originally listed on the NASDAQ and is now traded on the OTC Markets Group's over-the-counter exchange, the OTCQB. There exists also, admittedly, a possibility that firms might have been, or are, dual-listed.

A substantial amount of the dataset has been gathered from Hoover's inc.'s website[5] including: price information, the lead underwriter, the date of the IPO, and the information needed to calculate both the companies' respective market capitalisations at the time of the IPO, and the ratio of shares offered to outstanding.

The firms' age have been calculated using a the difference in years between their IPO and dates of incorporation. The respective dates of incorporation found using their official S-1 filings available through the US Securities and Exchange Commission's EDGAR file repository.

The number of companies going public each year from 2000 to 2013 in the US has been taken from IPOScoop's webiste. According to IPOScoop, 2.362 firms went public during our chosen time period, the number of IPOs each year well be used to determine the possible existence of 'hot issue markets'. Identifying bull and bear markets over such a short time period (13 years) might be misleading as they are generally considered to be long-term market trends. However several periods where stock prices were showing an upward trend for several years, followed by a shorter downward correction, have been identified. While the DJIA and the Nasdaq Composite trend together over the long-term, some short-run corrections will not be as deep or lasting, depending on the index. The periods with generally rising stock prices identified on the NASDAQ and NYSE are: from April 2003 to October 2007, and from March 2009 up to and including 2013. In the year 2000, January and February show rising stock prices on the NASDAQ due to the tech bubble, but the sample contains no IPOs from that exchange during this specific period. The U.S might not have completely recovered from the Great Recession, and there was a smaller crack in 2011, but stock prices have to some extent been rising since 2009.

The IPOs' lead underwriters have been ranked according to their reputation score from Ritter (2004) using the Carter and Manaster ranking system .At the time of writing, some of these underwriters have disappeared, for instance Lehman Brothers. Others have been acquired by their competitors:

[5] See the appendix.

Merrill Lynch is now owned by Bank of America.

To analyse underpricing differences across economics sectors, the analysis adopts the Industrial Classification Benchmark (ICB). Some slights modifications have been made: the technology and telecommunications sectors have been grouped together under the label "IT sector"; also, the energy, commodities, and utilities sectors have been merged into one sector. As shown in the table 1, preliminary tests suggest that the sample firms in the customer services and IT industry exhibit the highest levels of average underpricing. Also, the underpricing appears to be the lowest for the financial and the energy sector. Thus the regression analysis will show how the average level of initial return varies across these four industries, using the remaining three sectors as the control group.

Table 1: Underpricing by industry

Industry	Number of firms	Average underpricing
Customer Goods	79	16.90 %
Customer Services	69	23.30 %
Energy, Utilities and Commodities	129	5.90 %
Financials and Real Estate	134	7.70 %
Health Care	93	12.00 %
Industrials	125	11.20 %
IT and Communications	153	21 %

5.2 Variables

Using the dataset, 16 different variables have been modelled to test the hypotheses introduced in section 4.2.

One dependent variable: *mispricing*.

The dependent variable which describes the level of underpricing of a stock IPO is *mispricing*, as the hypothesis that the sample IPOs are underpriced has yet to be confirmed, the variable refers to the level of initial return on an IPO. Furthermore, when *mispricing* takes on a negative value, the respective IPO is in fact overpriced: should the independent variables have negative slope coefficients, they will have a negative effect on underpricing.

Six independent non-dummy variables: *rank, age, lratio, lprice, lsize, ltotal*.

rank refers to the level of prestige of the different underwriters. It refers to the modified Carter-

Manaster[6] ranking and thus takes on values from -9 to 9.
age is the age of the individual companies, calculated as the difference in the number of years between the date of the IPO and the date of incorporation.
lratio is the natural logarithm of the ratio of shares offered in an IPO to the number of shares outstanding. In taking its natural logarithm, one can see the effect of a percentage change in the number of shares offered to outstanding on underpricing.
lprice is the natural logarithm of the IPO offer price. The offer price is used to calculate the level of mispricing, so by using its natural logarithm one can avoid a linear relationship between independent and dependent variables.
lsize is the natural logarithm of the market capitalisation of the individual companies at the time of the IPO. It is the product of the number of shares outstanding and the offer price. Again, the logarithm is used to avoid potential problems relating to linearity.
ltotal refers to the natural logarithm[7] of the total number of IPOs going public the U.S during the sample period.

Nine dummy variables: *secfin*, *secen*, *secit*, *secserv*, *exc*, *excit*, *bull*, *jan*, *sept*.
The variables *secfin*, *secen*, *secit* and *secserv* are dummy variables indicating if a company belongs to the financial, energy, IT, or consumer services sector, respectively.
The dummy variable *exc* describes the exchange on which a company is listed, indicating if the company is listed on the NASDAQ.
Also, the variable *excit* is an interaction term between the the dummy variables *secit* and *exc*. It indicates whether a company is both: in the IT sector and listed on the NASDAQ.
The dummy *bull* indicates that a company went public during a bull-market; when aggregate stock prices were rising.
Finallty, there are two dummy variables for seasonality: *jan* and *sept* indicating that a company launched its IPO in the month of January, or September, respectively.

5.3 Statistics

The aforementioned variables have been combined to generate the following model (1):

$$mispricing = \alpha + \beta1*rank + \beta2*lratio + \beta3*lprice + \beta4*lsize + \beta5*ltotal + \beta6*age + \beta7*secfin + \beta8*secen + \beta9*secit + \beta10*secserv + \beta11*exc + \beta12*excit + \beta13*bull + \beta14*jan + \beta15*sept + \varepsilon i$$

[6] See the appendix.
[7] Logarithmic transformation has been used here to ensure a good fit.

The 782 sample companies show an average level of mispricing[8] of about 13.4%. In other words, an investor buying IPOs from this sample could have expected a positive first day return of 13.4% on his investment. Including only the 557 companies that experienced positive first day returns increases the average level of underpricing to 20.64%. For the entire sample of companies the maximum level of underpricing was 144.81% and the maximum level of overpricing was 27.27%, for the companies Illumina Inc. (ILMN) and S&W Seed Co. (SANWU), respectively. 167 companies were overpriced and the remaining 58 were what one could call 'correctly' priced.

Table 2: Descriptive statistics by price performance

	Underpriced	Correctly priced	Overpriced	Total
Number of companies	557	58	167	782
Mean initial return	20.64%	N/A	-6%	13.40%
Mean company age in years	19	22	19	19.5
Mean underwriter rank	8.2	7.6	7.6	7.7
Mean size of the IPO market	191	205	188	192
Mean ratio of shares offered	33.50%	42%	45%	36.60%
Mean IPO offer price[9]	$ 16.4	$ 14	$14.10	$15.74
Mean Market Capitalization[9,10]	$ 2 227	$ 643	$ 809	$ 1 841

The variables are reported in this form in table 2 to provide a good visual representation of the differences in company characteristics across the different levels of short-run performance. The empirical model uses the logarithmic form of four variables to reduce the possible impact of model misspecification, collinearity, and skewness and kurtosis. The summary statistics for the OLS coefficient of the model variables are reported in table 3.

[8] Again: a positive average level of mispricing implies that IPOs are on average underpriced.
[9] Inflation has not been accounted for in this analysis, its effect should however be negligible.
[10] In millions of U.S Dollars.

Table 3: Summary statistics of the regression variables

Variable	Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
mispricing	782	13.403	22.652	-27.272	144.812
rank	782	7.735	3.398	-9	9
age	782	19.56	29.35	0	242
lratio	782	-1.243	0.743	-6.298	0
lsize	782	6.267	1.157	3.091	13.19
ltotal	782	5.173	0.446	3.912	5.631
lprice	782	2.681	0.399	1.253	4.174
exc	782	0.396	0.489	0	1
bull	782	0.709	0.454	0	1
secfin	782	0.171	0.377	0	1
secen	782	0.164	0.371	0	1
secit	782	0.195	0.397	0	1
secserv	782	0.088	0.284	0	1
excit	782	0.112	0.316	0	1
jan	782	0.046	0.209	0	1
sept	782	0.061	0.24	0	1

6 EMPIRICAL RESULTS

6.1 Regression output

The presence of heteroskedasticity in stock returns is well documented[11], and we naturally suspect it to be the case for IPOs as well. Testing the original model depicted above using the Breusch-Pagan procedure, reveals a high level of heteroskedasticity. A robust model with adjusted for heteroskedasticity[12], the output of the regression is depicted in table 4: regression (1) is the original model, regression (2) is the robust model which the analysis is based on.

[11] See, for instance, Schwert and Seguin (1990).
[12] See Wooldridge for the OLS assumptions of the Multiple Linear Regression models.

Table 4: OLS coefficient, standard errors and robustness[13]

MODEL:	(1) mispricing	(1) Std. Err.	(2) mispricing	(2) Robust S.E
rank	-0.148	(0.227)	-0.148	(0.260)
age	-0.0586*	(0.0258)	-0.0586**	(0.0189)
lratio	-7.528***	(1.322)	-7.528***	(1.431)
lsize	-2.658**	(0.876)	-2.658**	(0.862)
ltotal	5.877*	(2.380)	5.877*	(2.975)
lprice	16.57***	(2.149)	16.57***	(2.257)
exc	5.018*	(1.982)	5.018*	(2.052)
bull	-4.839*	(2.327)	-4.839	(3.075)
secfin	-3.115	(2.357)	-3.115	(2.201)
secen	-8.017***	(2.402)	-8.017***	(2.060)
secit	10.50***	(3.041)	10.50**	(3.605)
secserv	8.233**	(2.783)	8.233*	(3.523)
excit	-8.348*	(3.875)	-8.348	(4.511)
jan	2.415	(3.540)	2.415	(2.643)
sept	7.517*	(3.093)	7.517*	(3.527)
_cons	-50.94***	(12.64)	-50.94***	(14.80)
N	782		782	
R^2	0.194		0.194	

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

After correcting the model for heteroskedasticity in model (2), the variables bull and excit become statistically insignificant, in addition those already insignificant in model (1). Interpretations of the results will refer to model (2) unless indicated otherwise.

6.2 Interpretations

We examine the relationship between and underwriter's reputation and the underpricing of the IPOs it underwrites. The findings reported in a table 4 does show that more reputable underwriters dampens the severity of underpricing, but this is only a slight effect. More importantly, this result is insignificant; the variable *rank*'s reported p-value is 0.581. This analysis can therefore not confirm Beatty and Ritter (1986) and Lowry et al. (2010), results that prestigious underwriters more accurately price IPOs. However, the literature is not in agreement on the subject of underwriter reputation and underpricing. Prestigious underwriters could have a positive effect on underpricing even if they generally priced their issues correctly: prestigious underwriters could decide to underprice if they had a substantial informational advantage over the issuing firm, as suggested by Baron (1982), an

[13] All models have been tested for multicollinearity using the Variance Inflation Factor (VIF) test. The results indicate only very mild multicollinearity between the explanatory variables.

advantage smaller underwriters would probably not possess. Furthermore it is important to emphasize that in the sample 68%of the issues were underwritten by institutions receiving the top score of 9 in the rankings. Also, 87% of the issues had an underwriter reputation score of 7 or above. One reason for this is that the number of IPOs and underwriter is involved in is a determinant of its reputation. Another possible explanation is that the dataset only contains stocks which were, or are, traded on the NASDAQ and NYSE. If this analysis covered over-the-counter stocks for instance, the results would possibly be more significant: many low-prestige underwriters have been convicted of microcap stock fraud[14] or other cases of market manipulation which produce large short-run returns.

The average sample company was a little over 19 years old when it launched its IPO, while the oldest firm had been incorporated 242 years ago. A total number of 593 companies were 20 years old or less at the time of their IPO which represents almost 76% of all firms. The results of the model indicate that the age of a firm is a highly significant determinant of its expected level of underpricing. One can therefore with some confidence conclude that the evidence presented here is in accordance with the studies by Loughran, Ritter et al. (1994) and Beatty and Ritter (1986): younger firms are associated with greater levels of ex-ante uncertainty and will therefore be more underpriced. However, the model predicts that the while being highly significant, the age of a firm only has a small effect on the expected underpricing of its IPO, this is most likely due to the fact that the vast majority of companies going public in the chosen time period were relatively young as described above.
One would expect larger companies to be in a good position to signal strength to investors and would thus not need to underprice their IPO. Indeed, the variable *lsize* is highly significant and has a negative effect on underpricing. Information about both old and large companies is likely to be easily accessible to the average investor; our verdict is that ex-ante uncertainty about the value of a company is greatly reduced with the age and size of the firm, thus eliminating the need for underpricing to signal quality.

An interesting result, which has not been extensively discussed in past research, is the strong link between the ratio of shares offered in the IPO to the number of outstanding shares and underpricing: *lratio* is highy significant and has a strong negative effect on underpricing. The model suggests that when a company decides to retain a large proportion of the shares, the IPO will experience large initial returns. This effect is interpreted as evidence supporting Ibbotson's (1975) signalling theory: companies offering only a small percentage of their shares could be planning to offer the rest in a seasoned offering. Purposely underpricing the IPO would generate high initial returns for the investors leaving a 'good taste in their mouths' and thus making them more likely to participate in the next offering(s). To confirm this however, one would have to see if there is a definite negative

[14] See, for instance the case: SEC vs. Stratton Oakmont, Inc. [1993] JES S.D.N.Y.

relationship between the number of shares offered and the probability of the company undertaking an SEO. The reported results might however indicate that companies underprice to maintain control. Assuming that companies who ration their shares wish to limit the influence of large shareholders, they could underprice in an effort to appeal to smaller investors as suggested by Brennan and Franks (1997) On the other hand the book-building process used in the U.S would according to Loughran et al. (1994) hinder the average investor's access to the IPOs in our sample. Other models would thus be required to determine which of the issuing firms' incentives is the strongest: signalling quality or maintaining control.

This paper hypothesised that another way of signalling quality is setting a high offer price for the IPO, in accordance with Ibbotson (1975). The reported results indicate the opposite: there is actually a strong positive relationship between the offer price and initial returns: the variable *lprice* is highly significant. We do not, however, postulate that a low offer price would signal quality to investors. Instead we suspect that expensive IPOs are in high demand and consequently exhibit large initial returns which are not the result of underpricing per se. Underwriters could be providing price support for the expensive IPOs as suggested by Ruud (1993), and the company insiders are possibly prohibited from selling shares during the IPO lock-up period. The high initial return on expensive IPOs is thus perhaps a consequence of a market with high demand and inelastic supply which puts an upward pressure on share prices.

There is strong evidence that underpricing varies across industries. All the industry dummy variables are significant with the exception of the variable for the financial industry: *secfin*. As expected the IT IPOs are the most underpriced. Considering the fact that the dataset does not cover the height of the dot-com bubble, the strong positive coefficient on the IT dummy indicates something besides speculative mania. Furthermore, there is also evidence that consumer services firms are on average severely underpriced. We are thus able to replicate the findings of both Gregoriou (2005) and Ali et al. (2010). Baron (1982) argued that underpricing occurs because of asymmetric information between issuer and underwriter. One can expect the underwriters to possess less of an informational advantage over financial sector firms, especially other investment banks, than they do over others. This also effectively eliminates any possible principal-agent problem. This explains the financial sector dummy's negative, although statistical insignificant, effect on underpricing. The negative effect of *secen* is can also be explained using Gregoriou's (2005) reasoning: it is likely that firms operating in the energy, commodities and utilities sectors are well-established profitable firms, considering for instance the large entry costs in the sectors. The average energy sector firm was 21 years old at the time of its IPO; contrast this with the average age of 13 years for IT firms, even though telecommunications companies are included. The firms' tangible assets and consumers' largely

inelastic demand for energy renders the industry less speculative[15], they will not need to signal quality to their associates and prospective investors by undepricing their securities.

The results on the dummy variables for seasonality and cyclicality are mixed. Underpricing seems to increase dramatically for IPOs launched in September. January shows a weak positive effect on underpricing, but the variable *jan* is not statistically significant and we cannot exclude the possibility that the month of January actually has a negative impact on underpricing. The myth is that aggregate stock returns are on average negative in September, thus the result that IPOs experience large initial returns in September seems to contradict the market's dogma and our hypothesis. However, underpricing could be increasing as a way of appealing to investors at a time when they are wary of buying securities. Like Dolvin and Pyles (2007) and Kliger et al. (2012) we therefore find evidence of mothly seasonality in IPO underpricing, though only for September specifically. Further explanation of the proposed calendar effects will require an extensive analysis of behavioural finance; we can thus only suggest that IPO returns mimic those of the aggregate stock market without detailing the exact causes of this phenomenon.

Contrary to the proposed hypothesis, there is no positive relationship between business cycles and underpricing: the dummy variable *bull* actually has a negative effect on underpricing, but is statistically insignificant after correcting for heteroskedasticity. This is not puzzling result however, considering the fact that IPOs from the height of the dot-com bubble are not included in the sample. On the other hand, there is evidence in favour of the existence of hot issue markets between 2000 and 2013: the variable *ltotal* has a strong positive effect on underpricing. An increase in the percentage of firms going public in a specific year greatly increases the expected underpricing of these IPOs. Consequently, Ibbotson and Jaffe's (1975) 'hot issue market' should theory still hold to this day.

The NASDAQ is a dealer's market: it quotes the different bid and ask prices of their market-makers. In contrast, the NYSE is an auction market where the market markets simply match bids from buyers and sellers. As predicted, the dummy variable *exc* indicating that an IPO was launched on the NASDAQ has a positive impact on initial returns. This analysis therefore rules in favour of Bennouri et al.' (2012) theory: the NASDAQ's dealer-type market[16] is likely to increase ex-post uncertainty and thus underpricing. We have also discussed the possibility that NASDAQ IPOs show signs of greater underpricing because riskier, smaller and younger firms are more likely to be quoted on this exchange. In section 6.3 we show that our results provide support for Corwin and Harris' (2001) findings on the effect of age and size on the firm's choice of listing.

The model looks for a possible added effect of NASDAQ IT companies on underpricing. The variable

[15] Commodities are notoriously volatile, and also prone to political risks if the companies operate in the Least Developed Countries, but few companies operating primarily in this sector are included in the sample.

[16] Bennouri et al. (2012) also find that after 2006, when the NASDAQ adopted the 'opening cross', IPO underpricing seemed to decrease. This has not been accounted for in this analysis.

excit was originally implemented to control the expected underpricing of IPOs on the NASDAQ for the fact that the exchange has generally been considered heavy in technology stocks. The sample IT companies however seem to be somewhat evenly distributed between the exchanges: only 57% went public on the NASDAQ. We expected *excit* to have a positive impact on underpricing, but the results show the exact opposite: NYSE IT IPOs seem to be more underpriced than their NASDAQ counterparts. However, since *excit* is no longer statistically significant when correcting for heteroskedasticity in model (2), this point will not be elaborated here.

7 MODEL LIMITATIONS AND EXPANSIONS

7.1Possible overfitting

As reported in table 4, in the original model (1), three variables, including two dummies, are not statisctically significant: *rank*, *jan* and *secfin*. Performing an F-test on these variables reveals that they are jointly insignificant: the reported p-value is 0.3853. Suspecting that the model is overfitted, i.e. that the variables are describing statistical noise, the three aforementioned variables have been excluded and the model re-estimated, again using its robust form:

$$mispricing = \alpha + \beta1*age + \beta2*lratio + \beta3*size + \beta4*ltotal + \beta5*lprice + \beta6*exc + \beta7*bull + \beta8*secen + \beta9*secit + \beta10*secserv + \beta11*excit + \beta10*sept + \varepsilon i$$

Estimating model (3) by dropping the jointly insignificant variables from model(1) show some interesting results, reported in table 5 are the differences between model(2) and model(3): while the dummy variable *bull* is still statistically insignificant, *excit* now becomes significant, also the R^2 coefficient of determination has only dropped slightly to 19.2 %. We can therefore suggest that NYSE listed IT firms exhibit greater signs of underpricing in their IPOs than those launched on the NASDAQ. To the author's knowledge, this has not been discussed in past research and we thus formulate a new theory: are investors on the NYSE more risk-averse than those on the NASDAQ? If so, these investors would perhaps expect to be compensated, for the perceived speculative nature of IT companies, by a lower IPO offer price.

Table 5: Differences in OLS estimates between model (2) and (3)

MODEL	(2) mispricing	(2) Robust S.E	(3) mispricing	(3) Robust S.E
rank	-0.148	(0.260)	-	-
age	-0.0586**	(0.0189)	-0.0552**	(0.0183)
lratio	-7.528***	(1.431)	-7.771***	(1.405)
lsize	-2.658**	(0.862)	-2.680**	(0.858)
ltotal	5.877*	(2.975)	6.252*	(2.941)
lprice	16.57***	(2.257)	16.01***	(2.263)
exc	5.018*	(2.052)	5.721**	(1.907)
bull	-4.839	(3.075)	-5.002	(3.054)
secfin	-3.115	(2.201)	-	-
secen	-8.017***	(2.060)	-6.621***	(1.660)
secit	10.50**	(3.605)	11.61***	(3.407)
secserv	8.233*	(3.523)	9.075**	(3.374)
excit	-8.348	(4.511)	-9.120*	(4.425)
jan	2.415	(2.643)	-	-
sept	7.517*	(3.527)	7.469*	(3.526)
_cons	-50.94***	(14.80)	-53.78***	(14.46)
N	782		782	
R^2	0.194		0.192	

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Based on the results in table 5, one can with some confidence conclude that the main determinants of underpricing of the IPOs in the sample are the variables: *age*, *lratio*, *lsize*, *ltotal*, *lprice*, *exc*, *secen*, *secit*, *secserv*, *sept*, and possibly *excit*.

7.2 Misspecification and omitted variable bias

The rationale behind using robust regressions has been to adjust the models for heteroskedasticity. Using a Ramsey reset test on both models (2) and (3), show that there is strong evidence of omitted variable bias which could account for a large proportion of the heteroskedasticity. According to Wooldridge (2009) this could cause the OLS to be biased and inconsistent[17]. Two proposed important determinants of underpricing is the contract type used in the offering, and the timeframe between the date of the setting of the offer price and the date the IPO is launched. However, since the sample is drawn entirely from the U.S markets, the IPOs generally do not exhibit important differences in these two aspects: the prices being determined using the book-building process and revealed shortly before

[17] If the heteroskedasticity was not due to omitted variable bias, i.e. the regressors were not correlated with the error term, the estimated OLS coefficients would still be unbiased.

the companies go public, as described by Chowdhry and Sherman (1996). The main determinants of underpricing are probably the omitted individual firm characteristics that cannot easily be quantified. This would also account for the low R^2 coefficients of less than 20%. Furthermore, excluded variables might be a cause of endogeneity bias on some of the included variables. The effect of the ratio of shares offered to outstanding is highly significant, but other factors influencing the effect of this variable might have been omitted, including: insider holdings and the number outstanding employee stock options, as discussed by Lowry and Murphy (2007) and Loughran and Ritter (2004).

7.3 The influence of the exchanges

Based on the research by Corwin and Harris (2001), we suspect that companies' characteristics such as their age, size and industry, influence their listing-choice. Indeed, the structure of the IPO market seems to be quite different across the two examined exchanges, as described in table 6 below:

Table 6: Descriptive statistics by exchange

Exchange	NYSE	NASDAQ
Number of companies	472	310
Mean initial return	11.28%	16.64%
Proportion of underpriced IPOs	71%	71%
Proportion of IT IPOs	14%	28%
Mean company age in years	22	16
Mean underwriter rank	8	7.4
Mean size of the IPO market	186	310
Mean ratio of shares offered	40.15%	32%
Mean IPO offer price	$ 17.21	$ 13.50
Mean market cap. of the offerings[18]	$ 2,555.71	$ 754.58

There is consequently a possible endogeneity bias between the dummy variable *exc* and other independent variables such as *age* or *lsize*. One possible solution to this problem is to use a Two-Stage Least-Squares estimation. However, wishing to expand the model to focuse on the differences in IPO underpricing across exchanges, we re-estimate a model for each exchange. Model (4) and (5) are estimated on the basis of model (3), excluding of course the variables *exc* and *excit*. The estimated robust models are depicted in table 7. Model (4) and (5) refer to NYSE and NASDAQ listed IPOS, respectively.

[18] In millions of U.S Dollars.

Table 7: Determinants of underpricing across exchanges

MODEL	(4) mispricing	(4) Robust S.E	(5) mispricing	(5) Robust S.E
age	-0.0261	(0.0180)	-0.0950	(0.0499)
lratio	-5.954***	(1.457)	-10.25***	(2.970)
lsize	-2.505**	(0.880)	-2.312	(1.906)
ltotal	1.000	(2.856)	12.85*	(5.190)
lprice	14.15***	(2.760)	17.33***	(3.633)
bull	2.642	(2.682)	-13.79*	(5.607)
secen	-6.150***	(1.715)	-12.04**	(4.295)
secit	12.01***	(3.438)	1.271	(3.064)
secserv	7.048*	(3.384)	12.10	(6.922)
sept	1.749	(2.959)	15.70*	(6.702)
_cons	-26.29	(15.04)	-84.68***	(25.22)
N	472		310	
R^2	0.185		0.233	

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The above results indicate that the other factors influencing IPO underpricing vary with the exchange. The reported R^2 coefficient of determination in model (5) is higher than in model (4); the independent variables included in this analysis seem to have a greater influence on the underpricing of NASDAQ IPOs.

The average market capitalisation of firms launching on the NYSE was 2,555 million USD compared to only 755 million on the NASDAQ, which is similar to Bennouri et al.'s (2011) findings that for IPOs, the NYSE companies are on average three times the size of the NYSE firms. A possible explanation for the greater significance of *lsize* for NYSE IPOs is thus that younger companies will have to compete for funding against large established corporations. Furthermore the average firm launched on the NYSE was 22 years old against only 16 for those listed on the NASDAQ. We thus have evidence in favour of Corwin and Harris' (2001) findings on the effect of age and size on a firm's listing choice. On the other hand, the *age* variable is no longer a statistically significant, and thus cannot be treated as a determinant of underpricing in neither model (4), nor model (5).

Table 6 also shows certain new and interesting results: the IT and consumer services sector firms are severely underpriced on the NYSE but show no statistically significant increases in underpricing on the NASDAQ. This leads us to hypothesise that the NASDAQ exchange is somewhat and somehow immune to sector-related variations in IPO underpricing. On the other hand, the NASDAQ appears to be prone to seasonality in IPOs' initial-returns: the variables for bull markets, hot issue markets and the September effect are now all statistically significant in model (5). This analysis cannot provide such evidence in favour of seasonality and cyclicality, including the presence of hot issue markets, on

the NYSE: none of the variables indicating seasonality or cyclicality in model (4) are significant and their magnitude is lower than in model (5).

8 SUMMARY AND CONCLUSIONS

The objective of this paper has been to verify the existence of underpricing in the Initial Public Offerings of stocks. Having outlined the factors identified by past research as the main determinants of underpricing, we put several of these to the test. Using a recent sample of American stock IPOs we provide support for the discussed asymmetric information and signalling theories on IPO underpricing: the age and size of the individual company, the number of shares it offers and its offer price are all predicted to influence its IPO's level of initial return once it starts trading. On the other hand, one cannot establish a relationship between underwriter reputation and underpricing based on the reported results. Considering that past research is not in agreement on the subject of underwriter reputation and underpricing, the failure to establish a direct link is not strange. This issue should perhaps be discussed in a separate paper with its own model, controlling for the many factors that might influence the effect of an underwriter's reputation.

We find evidence supporting the claims that underpricing varies greatly among industries. In particular we find that the underpricing of IT IPOs persists after the burst of the dot-com bubble, whereas industries with barriers to entry in the form of costs for instance, such as the energy sector, have less underpriced IPOs: however, we emphasize that this could in part be explained by IT firms being younger and smaller than others.

We have covered the issue of seasonality and cyclicality in IPO initial returns, basing the analysis on both old and new theories. The evidence presented suggests the existence of hot issue markets in the United States. Based on recent findings in behavioural finance, we propose the existence of a September effect in IPO returns, we boldly hypothesise that this effect is stronger for IPO returns than for stock returns in general considering the contradicting evidence presented by past research.

The most interesting finding in our opinion is that IPOs launched on the NASDAQ are more severely underpriced than those on the NYSE. This leads us to propose to superiority of auction-type exchanges over dealer markets in reducing ex-post uncertainty and consequently underpricing. We finally decided to deepen the analysis of IPO underpricing across stock exchanges, and found that certain characteristics are more likely to influence initial returns depending on the exchange. Should the presented findings be confirmed by future research, we would be able to propose the following: Investors should pay particular attention initial return variations across economic sectors for IPOs on

the NYSE, but the seasonality in initial returns are a more stressing issue for NASDAQ IPOs. We could additionally advise smaller companies to go public on the NASDAQ to reduce the likelihood of their shares being sold cheaply. Being NYSE-listed however could possibly be a signal of quality which ensures future funding, but this can only be confirmed by an analysis of long-run IPO and SEO returns.

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APPENDIX: DATA SOURCES

The purpose of this appendix is to provide further detail concerning the sources and modelling of the dataset.

- Price information:

The chosen source for price information is Hoover's Inc.'s website. The company is a subsidiary of Dun & Bradstreet inc., a provider of business information and a former Fortune 500 company which has been the target of numerous malpractice lawsuits. The firm's legal troubles are related to its marketing techniques and not its IPO research, thus there should not be any reason to question the integrity of the dataset. Other companies such as Thomson Reuters provides substantial information on IPOs, however this information is only available to paying customers.

- Economic sectors:

The IPOs have been grouped by industry using the Industrial Classification Benchmark (ICB) developed by the Dow Jones and FTSE groups in 2005. IPO samples are generally small compared to stock samples: the dataset includes 'only' 782 companies so they have been grouped by sector, although there is a distinct possibility of differences in underpricing levels across subsector as well. The subsectors within a specific ICB sector also have varying degrees of heterogeneity: the "Industrials" sector for instance groups together companies such as marketing and airlines, which is why it would be ideally suited to be part of the control group.
The only drawback with the ICB system in the author's view is simply that it does not include a cyclical and non-cyclical classification, as this groups firms that move differently with the market. Such a distinction would be interesting when analysing cyclicality in IPO underpricing.
Finally, the Telecommunications sector has been merged with the Technology (i.e. IT) sector, even though the Telecommunications sector usually has more tangible assets. Also, the energy, commodities and utilities sectors have been merged; some firms are hard to categorize as they operate in all three subsectors. Furthermore, the original dataset only includes 8 utility companies and conclusions could not easily have been drawn from such a small sub-sample.

- Underwriter Rankings:

The original underwriter rankings reported by Ritter (1994) have been slightly modified. The original rankings only assign negative value of -9 to an underwriter if it did not have a leading role in any IPOs during a specific period. This analysis however, assigns the value of -9 to some low prestige

underwriters given that: they were originally given a score of -9 by Ritter (1994), and they had the role of lead underwriter in only one of the sample IPOs. The reason for this is to further distinguish between low-prestige underwriters: the distribution of underwriters is strongly skewed towards those having a high ranking score, the number of IPOs they underwrite being a determinant of their rank. Finally, the underwriter rankings were last updated in 1994, and thus might not be fully accurate as of 2014.

- Websites used to collect and model data:

http://www.hoovers.com/100007201-1.html
http://www.nasdaq.com/markets/ipos/
https://www.sec.gov/edgar.shtml#.U1lv2_ldXqE
http://www.research.stlouisfed.org/fred2/
https://www.iposcoop.com/
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