Tilburg University

Underpricing in the IPO market

Master Thesis

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Abstract

This paper examines the anomaly of short-term underpricing in the IPO market by analysing a range of prominent models based on information asymmetry between the different participants of the IPO process, i.e. the investors, the issuers, and the investment bankers. For a total of 2350 US IPOs during 2000-2014, I observe an average level of underpricing of 13.45%. I perform several regressions by using different proxies for information asymmetry and find that information asymmetry plays a "modest" role in today's underpricing. I find that offer price and market capitalization are positively related to underpricing. I also show that NASDAQ-listed stocks have a significant influence on the level of underpricing in comparison to AMEX-, ARCA-, and NYSE-listed stocks and that the age of the company is negatively related to underpricing.

1 Introduction

Initial public offerings (IPOs) emerge when companies decide to enter the equity market by selling their stock to the public. It is widely acknowledged that IPOs are subjected to three different anomalies, namely, short-term underpricing, cycles in underpricing[1], and long-term underperformance. However, despite the extensive literature attempting to explain these anomalies, there still has been no satisfactory answer to the causes of these phenomena.

In particular, the pricing of IPOs has been subjected to much academic debate. The presence of underpricing in the IPO market is repeatedly shown for various stock markets among various countries for different periods in time. According to Ibbotson et al. (1994), short-term underpricing in the US results in an average first-day return of 10-15%. Although all these studies find unanimously evidence for the existence of underpricing, it remains to been seen what is causing this apparent inefficiency. Loughran and Ritter (2004) argue that reasons for underpricing vary across time and environment.

Due to the immense scope of recent IPOs like Facebook and Alibaba, there is again much emphasis placed on the process of going public and the performance of these companies. Strengthened by the disagreement about theories explaining the anomaly of underpricing and the accumulation of prior research around the Internet Bubble of 1999-2000, this paper aims to investigate the role of information asymmetry in underpricing for today's market. This leads to the following research question:

What is the impact of information asymmetry on underpricing in the IPO market?

I will attempt to answer this question by initially obtaining deeper insights in the anomaly of short-term underpricing. What is the anomaly of short-term underpricing? Discrepancy between the offer price and the closing price and the forthcoming underpricing of IPOs seems to be the rule rather than the exception, according to results from previous studies for different countries across the world.

[1] Also known as the "hot issue" market. IPO activity appears to move in cycles, according to Ritter (1984) hot issue periods are characterized by a large number of IPOs and high initial returns (as opposed to "cold issue" markets).

Literature in the field of IPOs produced several explanations for the anomaly of short-term underpricing. This subsequently leads to the question: What are the theories around underpricing? The current literature presents a comprehensive enumeration of theories. One of the most argued, if not the most argued, theories are based on asymmetric information. This paper analyses a range of prominent models based on information asymmetry between the different participants of the IPO process, i.e. the investors, the issuers, and the investment bankers.

Using data on 2350 US IPOs, from 2000 until 2014, I will try to find reasonable explanations for high initial returns (i.e. underpricing) of IPOs. These initial returns are measured as the percentage change from the offer price to the closing price on the first day. First, I will perform an initial return analysis for the US IPO market. This part is intended to create a better understanding of the distribution- and levels of underpricing for the 2000-2014 period. In accordance with Ibbotson and Jaffe (1975) underpricing occurs only during particular periods and according to Ritter (1984) underpricing is focused in particular industries. Therefore, I will also perform an initial return analysis among industries. Moreover, I will give deeper insights in the distribution of IPOs among years, industries, and exchanges on which the security is traded. Secondly, I will perform a regression analysis for the US IPO market. I will relate different sources of information asymmetry to underpricing and by using proxies for information asymmetry I will try to find whether information asymmetry is explaining underpricing. I will also include several time- and exchange-related variables to check their explanatory power on the level of underpricing.

The rest of the thesis is organized as follows. In the next chapter, the literature review, theoretical and empirical interpretations around underpricing will be discussed. The most important theories and results from earlier research will be provided and these are used to set the hypotheses around the relationship between multiple economic variables and the level of underpricing in the IPO market. In the third chapter the underlying data and methodology of my research is presented, which is used for testing the hypotheses. The fourth chapter shows the results of my research and the forthcoming inferences for the hypotheses. The fifth chapter reports an overview of my research and leaves room for discussion. This chapter looks at my research from a different point of view and contributes to the bigger picture. In the last chapter a summary and an overarching conclusion will be provided, which tries to answer the research question in the best possible way.

2 Literature review

Worldwide, every day, multiple firms decide to go public in order to raise new capital. The first time a firm goes public is called an Initial Public Offering or an IPO. The pricing of IPOs has been subjected to much academic debate. Past decades, many studies have tried to find answers to the IPO anomaly of short-term underpricing. Still there is no clear uniform answer to what causes this anomaly to exist.

2.1 The anomaly of short-term underpricing

Despite the disadvantages of becoming a publicly traded company, many companies believe that the benefits of raising capital outweigh the costs of the IPO process, the compliance with strict regulatory requirements and the disclosure of information. When a company decides to offer stock to the public, usually the assistance of an underwriting firm is requested to determine the offer price and timing. However, discrepancy between the issuing prices, set by the underwriter, and the market prices is a common phenomenon. The forthcoming anomaly of short-term underpricing is expressed by high initial returns, usually measured as the difference between the offering price and the closing price on the first day.

The presence of underpricing in the IPO market is repeatedly shown for various stock markets among various countries for different periods in time. From well-developed markets in the US to emerging and frontier markets in Asia and Africa. Loughran and Ritter (2004) observed data for 25 countries and found that the IPOs were underpriced in all these countries. The existence of underpricing shows signs of persistency.

According to Ibbotson et al. (1994), short-term underpricing in the US results in an average first-day return of 10-15%. The study investigated the 1960-1992 period and showed the persistence of underpricing during this whole period. Ibbotson et al. (1994) found an average first-day return of 21.3% for the 1960s, 9.0% for the 1970s, 15.2% for the 1980s and 10.9% for the first two years of the 1990s. Loughran and Ritter (2004) examined the 1980-2003 period and found an average initial return of 65% during the Internet Bubble of 1999-2000. Similar results hold for European markets. Ljungqvist (1997), for instance, found an average

level of underpricing of 9.2% for German IPOs during the period 1970-1993. Wasserfallen and Wittleder (1994) even found a higher average of 17.6% for 1970-1987[2].

For emerging markets, average levels of underpricing of above 60% are identified (Jenkinson and Ljungqvist, 2001; Ritter, 2003). There are even studies that report Chinese underpricing levels of above 200 percent. Also frontier markets are faced with underpricing. Gana and El Ammari (2008) studied the Tunisian market and found significant initial underpricing of about 19% for the 1992-2006 period.

Although all these studies find unanimously evidence for the existence of underpricing, it remains to been seen what is causing this apparent inefficiency. Why do firms leave money on the table? Especially for well-established and seemingly efficient stock markets in the US. The next section will enhance this question and discusses the theories around underpricing.

2.2 Theories around underpricing

Literature in the field of IPOs produced several theories that claim to have answers on what is explaining short-term underpricing in the IPO market. Below I will review a range of prominent models around the anomaly of short-term underpricing. All of them can be classified as a result of information asymmetry between the parties involved in the IPO process, i.e. the investors, the issuers, and the investment bankers[3].

2.2.1 Information asymmetry between investors

The winner's curse of Rock (1986) states that information asymmetry between investors is the reason for IPOs to be underpriced. He argues that there are two groups of investors, informed and uninformed investors. Informed investors have better information about the prospects of the firm and the fair value of the shares. Therefore, these investors only buy shares that are priced below their fair value. Contrary to these informed investors, the uninformed investors

[2] Note that this level of underpricing is higher than the level observed by Ljungqvist (1997) but also note that the conclusions are based on a sample with a different outlier treatment and a shorter time frame. Besides a drop in the extent of underpricing towards the late 1980s and early 1990s lowers the total level of underpricing when taking these years into account.

[3] Note that I use the terms "issuer" and "company (that is going public)", as well as "underwriter" and "investment banker", interchangeably.

do not have this information and are saddled with the winner's curse (i.e. the winner will tend to overpay). Uninformed investors are often faced with the problem of adverse selection. This means that when the offer price is higher than the expected value of the shares, the uninformed investors receive all the shares they asked for, while in the opposite situation nearly all shares go to the informed investors (Fabrizio, 2000)[4]. However, under the assumption that all market participants act rational, uninformed investors do require a higher return to compensate for this allocation disadvantage. Underpricing is required to motivate them to participate in the market because uninformed investors only consider buying shares if the price is low enough to compensate for the disadvantage of the information asymmetry (Michaely and Shaw, 1994)[5].

Beatty and Ritter (1986) have used the model of Rock (1986) to build on the assumption of information asymmetry between investors. They argue that underpricing is related to ex ante uncertainty. In the situation that the value of the company is unknown as well as the performance of the shares in the future, investors are driven to obtain more information. When the issuer is not willing to reveal more information, investors are faced with higher costs to get information. More uncertainty means more risk, especially for uninformed investors. This risk has to be compensated by a higher expected return as a result of lowering the offer price. According to Beatty and Ritter (1986) underpricing compensates for this risk. They argue that the degree of uncertainty on share value is positively related to underpricing, meaning that higher levels of uncertainty cause underpricing to be higher.

2.2.2 Information asymmetry between issuers and investors

The signaling hypothesis is based on the assumption of information asymmetry between the issuer and the investor, whereby the issuer has information about the prospects of the firm that is not available to investors. The majority of the signaling models distinguish two types of firms. The low quality or "bad" firms and the high quality or "good" firms (Hutagaol, 2005).

[4] According to Bansal and Khanna (2012), IPOs will be oversubscribed by informed investors in the case of underpricing.

[5] Under the assumption that uninformed investors do not have a priori knowledge that informed investors will not participate.

Allen and Faulhaber (1989) argue that the issuer holds the best information about the prospects of the firm. In their research they argue that, under certain circumstances, firms with the most favorable prospects find it optimal to signal these prospects by underpricing their initial issue of shares[6]. This signal informs the investor that the firm is able to carry the costs of underpricing, which in turn, follows the reasoning of Ibbotson and Jaffe (1975) that underpriced IPOs are leaving "a good taste in the mouth of investors" and ultimately lead to the circumstance that future underwritings from the issuer can be sold at better prices[7]. This does not mean that uncertainty about the type of firm, good or bad, is completely excluded at the moment of the second offering. But does mean that good firms have a higher probability to be evaluated as good by investors (Fabrizio, 2000). According to Allen and Faulhaber (1989), investors interpret future dividend results more favorably. Besides, bad firms are not able to underprice because they cannot carry the loss resulting from underpricing. This explains underpricing as an equilibrium signal of firm quality. Ritter (1984) argues that there is a concentration of IPOs with strong underpricing at certain times and in specific sectors.

Welch (1989) also argues that underpricing is a good way to signal. However, he states that the quality of the company becomes obvious between the first and the second offering. Bad companies have a low incentive to imitate good companies because of the high costs. When good companies draw the attention to their quality by underpricing, the costs of imitating for the bad companies become even higher.

2.2.3 Information asymmetry between investment bankers and between investment bankers and investors

Baron (1982) developed a model based on the principal-agent theory and states that in the situation in which the investment banker and the issuer are not equally informed, a "firm commitment contract" is not optimal. He argues that when the investment banker is better informed than the issuer and the issuer is not able to access or monitor this information, for the issuer it pays off to make use of a "delegation contract". Consequence of this type of

[6] Underpricing is a signal that requires no monitoring and therefore is a powerful tool. Allen and Faulhaber (1989) find that the price and the quantity of the IPO can be used for signaling. Other than the offer price, choice of underwriter (Booth and Smith, 1986) and choice of auditor (Titman and Trueman, 1986) can be used.
[7] The result in practice is that one draws the attention with a small package of highly underpriced shares during the first offering, to optimally profit during the next offerings when the attention is already drawn (Fabrizio, 2000).

contract is that the issuer not only depends on the distribution services, as in the situation of a "pure distribution contract", but also depends on the advising services of the investment banker. Meaning that the decision about the offer price is delegated to the investment banker. Baron (1982) also gives an explanation for the underpricing of new issues, indicating that the optimal offer price is lower than the "first-best" offer price, for compensation purposes of the investment banker. According to Loughran and Ritter (2002) underwriters find it less costly to market an underpriced IPO.

However, there are also theories focusing on the differences between investment bankers. In particular, the difference in reputation and the role of these prestige differences in the level of underpricing. A well-known model is developed by Carter and Manaster (1990). The model builds on the argument of Rock (1986) that underpricing is required to motivate uninformed investors to participate in the market, as a compensation for the allocation disadvantage.

Carter and Manaster (1990) extend the theory of Rock (1986) by arguing that investors have scarce resources to obtain information. This induces investors to mainly obtain information on the most risky investments, resulting in a shift of "informed investor capital" to risky IPOs, which causes these IPOs to be confronted with higher levels of underpricing[8]. Moreover, Carter and Manaster (1990) argue that underpricing is costly for the issuer. The underpricing of the risky IPOs is able to hurt the issuer of less risky IPOs and because of this, low-risk issuers want to unveil their nature by selecting reputable underwriters who are able to market low-risk IPOs. Besides, prestigious underwriters, in turn, will only market low-risk IPOs to maintain their reputation. In addition, because reputable underwriters are associated with low-risk IPOs, investors have less incentive to acquire information. This reduces the uncertainty of and information asymmetry between both groups of investors, the informed and the uninformed.

[8] The information asymmetry between informed and uninformed investors becomes bigger, resulting in higher levels of underpricing (Rock, 1986; Beatty and Ritter, 1986).

2.3 Hypotheses

To test whether these theories hold, I examine the relationship between measures of information asymmetry and the level of underpricing in the IPO market. Several studies provided empirical evidence for the relationship between information asymmetry and underpricing by using proxies for asymmetric information. Below I relate different proxies for information asymmetry to the level of underpricing[9]. This leads to the first four hypotheses.

Issue size

According to Miller and Reilly (1987) the issue size reflects uncertainty on new issues. They argue that larger offerings are often carried out by more established companies, which reduces the perceived risk of investors (Boudriga et al., 2009). Carter and Manaster (1990) find a significant negative relationship between the size of the offer and the standard deviation of IPO returns. Besides, they argue that investors use offer size for valuing IPOs[10]. Megginson and Weiss (1991) show that larger IPOs experience less underpricing[11]. These results lead to the following hypothesis:

H1: There is a negative relationship between the issue size and the level of underpricing

Market capitalization

Boubaker and Mezhoud (2011) argue that market capitalization is a signal to inform the investor about the quality of the company. According to Sohail and Raheman (2009) and Bansal and Khanna (2012) there is a significant positive relationship between market capitalization and the level of underpricing. Bundoo (2007) argues that bigger companies are more underpriced, which confirms these results. Baker and Wurgler (2007) argue that low-capitalization stocks of young and unprofitable growth companies are less sensitive to investor sentiment. These inferences lead to the following hypothesis:

H2: There is a positive relationship between the market capitalization and the level of underpricing

[9] Note that these economic variables are marked extensively as proxies for information asymmetry in current and past IPO literature, for instance by Bansal and Khanna (2012) and Islam et al. (2010). Apart from the question whether these proxies are related to underpricing, I assume that these proxies are correctly representing the sources of asymmetric information.

[10] Evidence of previous studies show mixed results on the relationship between offer price and underpricing.

[11] However, they do find that for a given level of underwriter reputation, larger and more diffuse issues require more underpricing to market them successfully.

Age of the company

According to Boubaker and Mezhoud (2011) younger companies face bigger ex ante uncertainty and younger companies have less information available, which will be reflected in a higher level of underpricing (Bilson et al., 2003)[12]. This follows the reasoning of Beatty and Ritter (1986) who argue that underpricing is related to ex ante uncertainty. Muscarella and Vetsuypens (1989) find evidence that the age of the firm is significant and negatively related to underpricing. Megginson and Weiss (1991) use age of the firm as a control variable for the degree of information asymmetry and also find a significant negative relationship between the age of the company and the level of underpricing[13]. These results lead to the following hypothesis:

H3: There is a negative relationship between the age of the company and the level of underpricing

Reputation of the underwriter

In accordance with previous studies, underwriter reputation is negatively related to short-term underpricing (Logue, 1973; Johnson and Miller, 1988; Booth and Chua, 1996). As discussed, reputable underwriters reduce information asymmetry (Carter and Manaster, 1990), prestigious underwriters are able to reduce agency costs of the issuer (Boudriga et al., 2009), and issuers of low-risk IPOs select reputable underwriters who are able to market their IPOs. Titman and Trueman (1986) argue that this selection is a way to signal the quality of the issue. Carter and Manaster (1990) use underwriter rank as a proxy for reputation and the vast majority of their empirical results support their theory, implying that underwriter prestige and underpricing are negatively related. They find significant negative relationships between the reputation of the underwriter and the scale of the IPO price run-up. Michaely and Shaw (1994) and Megginson and Weiss (1991) support these findings, while respectively using capital of the underwriter and market share of the underwriter as a proxy for underwriter reputation. These findings result in the following hypothesis:

H4: There is a negative relationship between the reputation of the underwriter and the level of underpricing

[12] According to Ritter (1991) older companies have more information available which, in turn, helps to reduce the information asymmetry.

[13] They find this result even though the presence of venture capitalists, which tend to be younger firms, significantly lowers the level of underpricing (after controlling for issue size and quality of the underwriter).

Period of the IPO and the exchange on which the stock is traded[14]

Ritter (1984) argues that the underpricing of IPOs is a common phenomenon for markets in both developed and emerging economies. He states that there is a concentration of IPOs with strong underpricing at certain times and in specific sectors. The occurrence of underpricing depends on the period in which the firm decides to go public. Ibbotson and Jaffe (1975) show that the level of underpricing is cyclical. Loughran and Ritter (2004) highlight that reasons for underpricing vary across time and environment. The winner's curse was the main reason for underpricing in the 1980s, but not during the Internet Bubble of 1999-2000. These inferences lead to the following hypothesis:

H5: There is a relationship between the period of the IPO and the level of underpricing

According to Uddin (2001), the exchange on which the stock is traded has influence on the level of underpricing. This inference leads to the following hypothesis:

H6: There is a relationship between the exchange on which the stock is traded and the level of underpricing

In the next chapter, the data and methodology of my research is presented. This chapter enables me to test whether the theoretical and empirical implications, underlying the hypotheses, hold.

[14] Note that these both hypotheses are not directly based on the information asymmetry theories. However, H5 is aimed to test whether change in underpricing across time can be assigned to a change in the degree of information asymmetry and H6 is aimed to test whether the level of underpricing is different for the exchanges on which the stock is traded.

3 Data and Methodology

This chapter provides the empirical foundation for my research, in which I try to find reasonable explanations for high initial returns (i.e. underpricing) of IPOs. The chapter is divided into four sections. Section 1 will discuss the data and data sources which I use for this research. Section 2 is intended for bridging the gap between theory and empiricism by defining variables that may interact with the underpricing of IPOs. This section serves as a prelude for section 3, in which the variables are translated into fully measurable units. In the last section, section 4, the methodology for regression will be provided.

3.1 Data description and data sources

Data for this research is obtained from multiple sources. The starting point of collecting useful data is to obtain deeper insight into which companies went public during recent years. This data is collected from "SCOOP Track Record from 2000 to present" and shows which US IPOs occurred during the period 2000-2014, accompanied by the offer price and the closing price of the stock on the first day[15]. These both variables are used to obtain the dependent variable "Initial Return" for in total 2350 IPOs. The IPOs represent offerings of companies, of diversified sizes and ages, operating in all economic sectors (i.e. energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology, telecommunication services, and utilities)[16].

The data for my independent variables is achieved from three different sources. First, the age of the company is determined by using the Field-Ritter dataset of company founding dates[17]. The same dataset is used for indicating IPOs of roll-up companies (i.e. companies that are primarily built by acquiring smaller companies in the same industry)[18]. These variables need to be substantiated by the remarks that only the IPOs with fully reliable founding dates are

[15] A link to this dataset can be found on Professor Jay Ritter's webpage.
[16] Note that in the next chapter, the IPOs will be segmented by company characteristics.
[17] The Field-Ritter dataset of company founding dates, as used in L.C. Field and J.M. Karpoff "Takeover Defenses of IPO Firms" in the October 2002 *Journal of Finance* Vol. 57. No. 5, pp. 1857-1889, and T. Loughran and J.R. Ritter, "Why Has IPO Underpricing Changed Over Time?" in the Autumn 2004 *Financial Management* Vol. 33, No. 3, pp. 5-37.
[18] Note that I use this data to check whether acquisitions in certain industries have an influence on the level of underpricing for these industries.

captured, reverse LBOs are given a founding date for the predecessor company, and for roll-ups the founding date of the parent company is used. Secondly, the reputation of the underwriter is determined by using the dataset on IPO Underwriter Reputation Rankings[19], retrieved from Professor Jay Ritter's webpage. I use these rankings to determine the reputation of an underwriter for different sub-periods in time (i.e. 2000, 2001-2004, 2005-2007, 2008-2009, and 2010-2014[20]). For each IPO during the period 2000-2014 I assign a rank to the lead underwriter(s) of the deal by checking the underwriter rank during the year of the deal. A comprehensive list of underwriters, that were ranked 8 or higher in at least one of the mentioned sub-periods, can be found in appendix A. Thirdly, all security-related items are achieved from the Center for Research in Security Prices (CRSP). These security-related items are offer price, closing price, shares outstanding, issue size, market capitalization, return on the S&P 500, and the primary exchange on which the security is traded. Lastly, the industry identification of the companies that went public is gathered from the Center for Research in Security Prices (CRSP)[21]. In the two following sections, the variables will be more specifically defined.

3.2 Variables

In order to find empirical evidence for the existence and causes of short-term underpricing I need to bridge the gap between theory and empiricism, by translating the theory into economic variables, which correctly cover the theoretical inferences discussed in the preceding chapter. Emphasize is placed on sources of information asymmetry, measurements of time and the role of listing markets. The next section will describe the explanatory variables that cover these key variables in the best possible way[22]. Here the key variables will be translated into measurable units.

[19] Professor Jay Ritter made several adjustments to improve the Carter and Manaster methodology of ranking underwriters.
[20] Under the assumption that the 2010-2011 reputation rankings for the underwriter remain unchanged for 2012, 2013, and 2014.
[21] The Standard Industrial Classification System is used for this identification. The United States Department of Labor offers a comprehensive list of industries with their associated codes.
[22] Within the limits of this research.

3.3 Data interpretation and data measurement

The dependent variable in this research is "Initial Return". This variable measures the first-day return of an IPO and gives insight whether the IPO is underpriced, correctly priced or overpriced. The initial return is calculated as the percentage change from the offer price to the closing price on the first day:

$$\frac{Closing\ Price - Offer\ Price}{Offer\ Price} \times 100\% \qquad (1)$$

In the remainder of this paper, the terms "initial return" and "level of underpricing" are used interchangeably[23]. The independent variables of this research are further defined in table I.

Table I
Independent Variables

Interpretation and measurement of the independent variables: Offer Price, Issue Size, Market Capitalization, Age of the Company, Reputation of the Underwriter (dummy), Primary Exchange (dummy), Roll-up Companies (dummy), Post-Internet Bubble (dummy), Crisis (dummy), and Post-Crisis (dummy). Remarks between brackets serve regression purposes.

Independent variables	Interpretation and measurement
Offer Price	The price at which new issued stock is offered to the public. This price is set by the underwriter and is stated in US $. [For regression purposes the natural logarithm value is used.]
Issue Size	The number of shares offered multiplied by the offer price. Stated in US $. [For regression purposes the natural logarithm value is used[24].]
Market Capitalization	The number of shares offered multiplied by the market price (at the end of the first day). Stated in US $. [For regression purposes the natural logarithm value is used[24].]
Age Company	The age of the company before going public. Stated in whole

[23] The level of underpricing is also measured as the percentage change from the offer price to the closing price on the first day, whereby negative levels of underpricing (i.e. negative initial returns) are interpreted as overpriced IPOs. The following chapter will use this interpretation for the calculation of the descriptive statistics. The average level of underpricing (i.e. average initial return) is composed by underpriced, correctly priced, and overpriced IPOs.

[24] Taking the natural logarithm after the multiplication of non-logarithm values. "Shares Outstanding" is the number of publicly held shares, the total number of shares the company has offered to investors when it went public.

	years (rounded off downwards). This is the difference between the starting year of the company and the year in which the company went public. [For regression purposes the natural logarithm value is used[25].]
Dummy Variables	
Underwriter Reputation	The value one is assigned if (at least one of) the lead underwriter(s) is ranked 8 or higher during the deal in the accompanying year. In all other cases, the value zero is assigned.
Primary Exchange	The value one is assigned if the security is traded on the NASDAQ. For all other exchanges, the value zero is assigned.
Roll-up	The value one is assigned if a company goes public that is primarily built by acquiring smaller companies in the same industry. If this is not the case, the value zero is assigned.
Post-Internet Bubble	The value one is assigned if the IPO occurred during 2001-2007. If this is not the case, the dummy takes a value of zero.
Crisis	The value one is assigned if the IPO occurred, during the start of the crisis, in 2008. If this is not the case, the dummy takes a value of zero.
Post-Crisis	The value one is assigned if the IPO occurred after 2008. If this is not the case, the dummy takes a value of zero.
Control Variable	
Return on S&P 500 Index	The return on S&P Composite Index at the end of the first day.

[25] Because the natural logarithm of zero is undefined, the natural logarithm of (1 + age of the company) is used.

3.4 Methodology

I will use the following model of OLS-regression to estimate the relationship between the independent variables and the level of underpricing.

$$Y_i = \alpha_i + \beta_1 X_{1_i} + \cdots + \beta_k X_{k_i} + \varepsilon_i \quad (2)$$

Where Y_i stands for the level of underpricing "Y" at company "i". I.e. the dependent variable Y denotes the level of underpricing for each individual company i that went public in the US from 2000 until 2014. The independent variables are represented by $X_1 + \cdots + X_k$. α is the point where the regression line crosses the dependent variable and $\beta_1 + \cdots + \beta_k$ are the different coefficients of the determinants of the dependent variable. Variable ε expresses the error term. This leads to the following model:

$$\boldsymbol{Level\ of\ Underpricing = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 d_1 + \beta_7 d_2 + \beta_8 d_3 + \beta_9 d_4 + \beta_{10} d_5 + \beta_{11} d_6 + \varepsilon} \quad (3)$$

Where:

X_1 = Offer Price

X_2 = Issue Size

X_3 = Market Capitalization

X_4 = Age Company

X_5 = Return on S&P 500 Index

d_1 = Underwriter Reputation

d_2 = Primary Exchange

d_3 = Roll-up

d_4 = Post-Internet Bubble

d_5 = Crisis

d_6 = Post-Crisis

4 Results

This chapter presents the results of my empirical research. Section 1 shows the descriptive statistics, which form the foundation of my empirical research and are meant to gain deeper understanding of the distribution- and levels of underpricing during the period 2000-2014. Section 2 emphasizes the results obtained from regression and section 3 uses the forthcoming inferences of section 1 and 2 for analyzing the hypotheses set by the theories around underpricing.

4.1 Descriptive statistics

This section is divided into two parts. For the first part I perform an initial return analysis on all US IPOs during the period 2000-2014. In the second part I reduce the sample size for further analyses and optimization for regression purposes of section 2. Figure I shows the average initial returns and the number of IPOs for the period 2000-2014. In totality, 2350 companies went public during this period. For this analysis, all IPOs are assigned equal weights.

Figure I
Average Initial Returns and Number of IPOs per Year

The sample consists of 2350 US IPOs for 2000-2014 with an offer price of at least $3.00. Information is obtained from the Center for Research in Security Prices (CRSP), IPOScoop.com and the Field-Ritter dataset of company founding dates. The initial return is calculated as the percentage change from the offer price to the closing price on the first day. The data plotted are reported in table II. The years are set along the horizontal axis. The number of IPOs (bars) and the average levels of underpricing (lines) are set along the vertical axes.

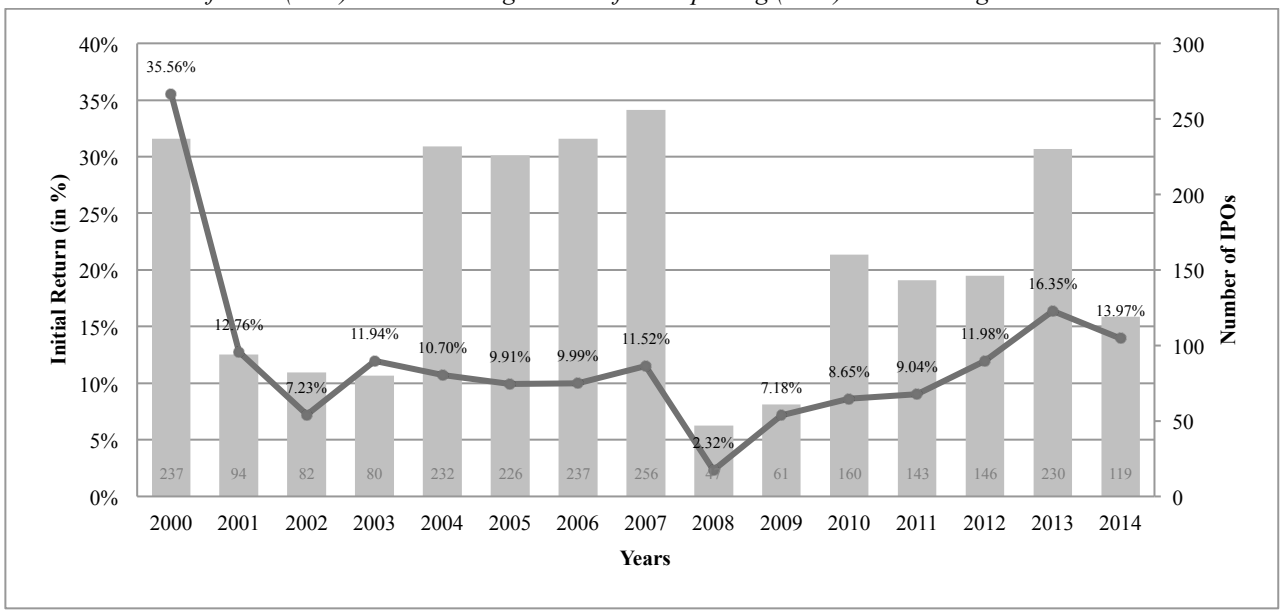


Table II reports the number of IPOs[26] and the mean- and median values of the initial returns, the offer prices, and the closing prices on the first day, for all years covered. With an overall initial return of 13.45%, again for this analysis all IPOs are assigned equal weights, there are two years which really attract the attention. The mean initial return peaked in 2000, during the Internet Bubble period. The mean initial return in this year was 35.56% and the median initial return was above 16%. This last value gives us more useful information about the distribution of the returns, which tells that 50% of the observations in 2000 are above the mentioned 16% initial return. The other year that sticks out is 2008. In 2008 the mean initial return was 2.32% and only 47 companies went public during this year. The zero percent median initial return argues that the number of underpriced IPOs and overpriced IPOs reached same levels.

Table II
Initial Returns, Offer Prices, and Closing Prices per Year

The sample consists of 2350 US IPOs for 2000-2014 with an offer price of at least $3.00. Information is obtained from the Center for Research in Security Prices (CRSP), IPOScoop.com and the Field-Ritter dataset of company founding dates. The number of IPOs and the mean- and median values of respectively initial returns, offer prices, and closing prices for the accompanying years are reported. The initial return is calculated as the percentage change from the offer price to the closing price on the first day. The offer price is the price at which new issued stock is offered to the public and the closing price is the price at the end of the first of trading (both stated in US $).

		Mean			*Median*		
Year	Number of IPOs	Initial Return	Offer Price	Closing Price	Initial Return	Offer Price	Closing Price
2000	237	35.56%	$14.08	$20.20	16.25%	$13.00	$16.38
2001	94	12.76%	$15.38	$17.36	8.59%	$14.00	$16.19
2002	82	7.23%	$16.35	$17.73	4.60%	$15.50	$16.88
2003	80	11.94%	$14.76	$16.69	7.16%	$14.25	$16.20
2004	232	10.70%	$13.47	$15.10	5.18%	$13.00	$14.04
2005	226	9.91%	$13.94	$15.80	2.54%	$13.75	$14.07
2006	237	9.99%	$14.18	$15.97	4.18%	$13.80	$15.20
2007	256	11.52%	$13.72	$15.59	3.36%	$13.50	$14.47
2008	47	2.32%	$13.41	$14.20	0.00%	$10.00	$10.00
2009	61	7.18%	$15.05	$16.30	0.90%	$14.00	$14.63
2010	160	8.65%	$13.14	$14.54	1.75%	$12.00	$12.75
2011	143	9.04%	$14.93	$16.66	0.92%	$15.00	$15.90
2012	146	11.98%	$15.07	$17.07	5.19%	$14.88	$15.05
2013	230	16.35%	$16.11	$19.01	6.91%	$15.00	$18.25
2014	119	13.97%	$14.84	$17.00	5.33%	$14.00	$14.71
All	2350	13.45%	$14.43	$16.73	4.68%	$14.00	$15.03

[26] The number of IPOs for 2000 and 2014 should be interpreted cautiously. The numbers captured in 2000 are collected from May until December 2000 and the numbers for 2014 are collected during the first five months of that year. For 2000, the real average initial return probably is higher than the given 35.56%, as in the spring of 2000 signs of the end of the Internet Bubble were present.

In order to obtain more in-depth knowledge I reduce the sample size of the US IPOs to a total of 1862 IPOs for which all information is available[27]. These IPOs show an overall initial return of 15.21%, which is slightly higher than the 13.45% mentioned earlier. Also here the IPOs are equal-weighted. The patterns of underpricing for both analyses are comparable, with the highest initial return in 2000 and the lowest in 2008. Table III reports the number of IPOs and the level of underpricing categorized by assets, sales, industry (tech versus non-tech), age, and underwriter reputation.

Table III
Initial Returns and Number of IPOs Segmented by Firm and Underwriter Characteristics

The sample consists of 1862 US IPOs for 2000-2013 with an offer price of at least $3.00. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP), the Field-Ritter dataset of company founding dates and the dataset on IPO Underwriter Reputation Rankings by Professor Jay Ritter, which builds on the Carter and Manaster (1990) methodology of ranking underwriters. Assets and sales are measured during the first quarter of listing (no adjustments for inflation). Firms with assets of $200 million or less are classified as small and firms with assets of more than $200 million are classified as large. Firms with 3-month sales of $40 million or less are classified as low sales firms and firms with 3-month sales of more than $40 million are classified as high sales firms. Firms are marked as technology companies following the classification of the Global Industry Classification Standard (GICS). The age of the company is the difference between the staring year of the company and the year in which the company went public. Firms with an age of 0-7 years are classified as young and firms of 8 years and older are classified as old. Low-prestige underwriters have an underwriter rank below 8 and high-prestige underwriters have an underwriter rank of 8 or higher. The initial return is calculated as the percentage change from the offer price to the closing price on the first day. Assets, sales, and industries are obtained from the CRSP/Compustat Merged Dataset sharing data on 1839 IPOs, whereby assets and sales are missing for respectively 11 and 56 firms.

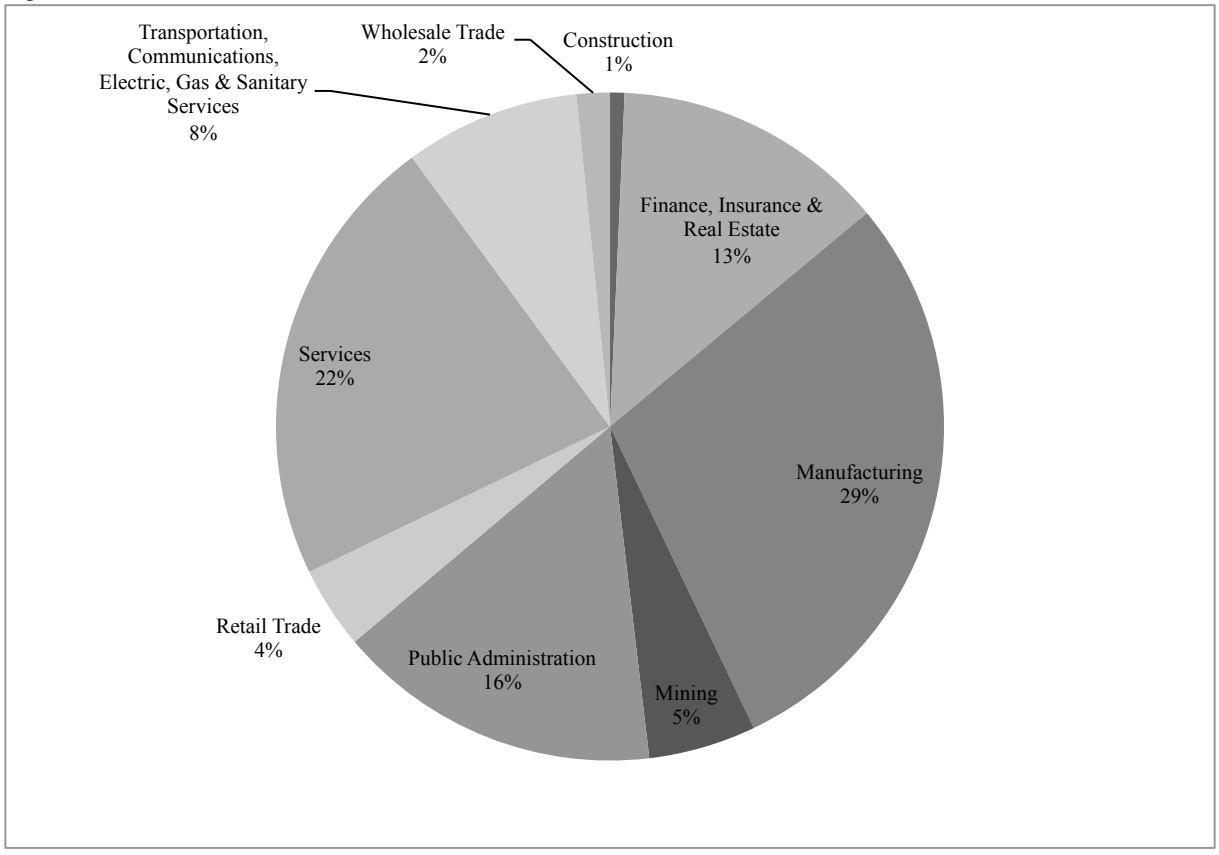
	2000-2013	
Segmented by	Number of IPOs	Initial Return
Assets		
Small	862	17.81%
Large	966	12.88%
Sales		
Low	661	15.61%
High	1122	15.40%
Industry		
Technology	490	25.55%
Non-technology	1349	11.39%
Age		
Young	795	15.97%
Old	1067	14.65%
Underwriter Reputation		
Low	362	8.31%
High	1500	16.87%
All	1862	15.21%

[27] Excluding all IPOs with missing or non-reliable data on at least one of the variables used for the remaining part of this section.

Figure II shows the distribution of IPOs among industries for the period 2000-2013[28]. In terms of the fraction each industry shares in the total number of IPOs, the Services and Manufacturing industries are highly represented. With a fraction of respectively 22% and 29%, the both industries are responsible for more than half of all IPOs during 2000-2013 (chart 1). The figure also shows the contribution of the industries to the total level of underpricing of 15.21% for the same period. Assigning equal weights to each IPO, the contribution of the Services and Manufacturing industries to the total level of underpricing, are again the highest with respectively 30% and 35% of the total average level of underpricing (chart 2).

Figure II
IPOs among Industries

The sample consists of 1862 US IPOs for 2000-2013 with an offer price of at least $3.00. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP) and the United States Department of Labor (USDL). The fraction of each industry in the total number of IPOs (reported in table IV) is plotted in the first chart. The contribution of each industry to the (total) average level of underpricing, whereby the initial return is calculated as the percentage change from the offer price to the closing price on the first day, is plotted in the second chart.



[28] Excluding all IPOs with missing or non-reliable data on at least one of the variables, which entails that 2014 is excluded from the analyses.

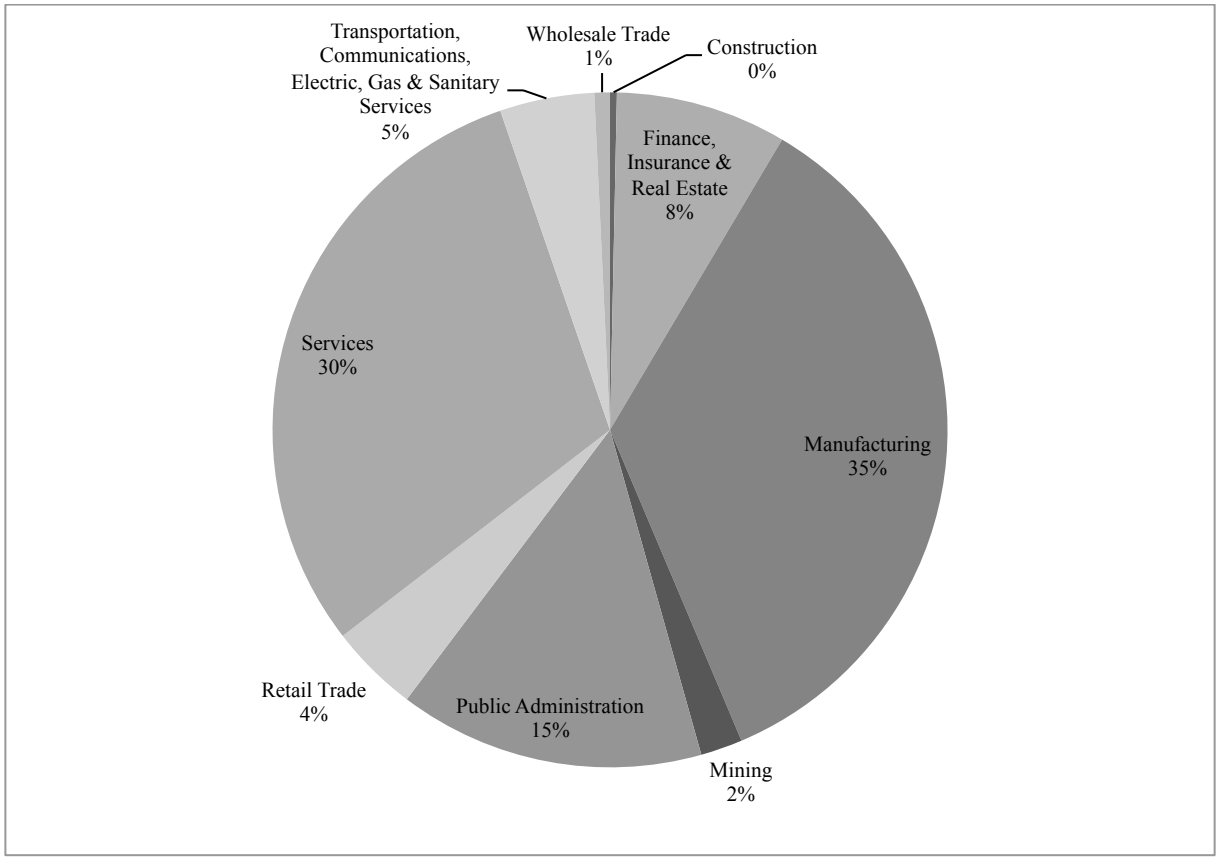


Table IV reports the number of IPOs and the mean- and median values of the initial returns, the offer prices, and the closing prices on the first day, for all industries during 2000-2013. With an overall initial return of 15.21%, again for this analysis all IPOs are assigned equal weights, there are a few industries that stand out in terms of initial returns. Services with an average initial return of 20.80% and Manufacturing with an average initial return of 18.45%. Both industries are represented by a high number of IPOs, which already is pointed out by figure II. A third industry which is characterized by high initial returns is Retail Trade, with an average of 16.31%. However, this industry represents much less companies that went public (i.e. 74), which is also pointed out by figure II. With only 4% of the total number of IPOs it contributes 4% to the total level of underpricing.

Table IV

Initial Returns, Offer Prices, and Closing Prices among Industries

The sample consists of 1862 US IPOs for 2000-2013 with an offer price of at least $3.00. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP) and the United States Department of Labor (USDL). The number of IPOs and the mean- and median values of respectively initial returns, offer prices, and closing prices for the accompanying industries are reported. The initial return is calculated as the percentage change from the offer price to the closing price on the first day. The offer price is the price at which new issued stock is offered to the public and the closing price is the price at the end of the first of trading (both stated in US $).

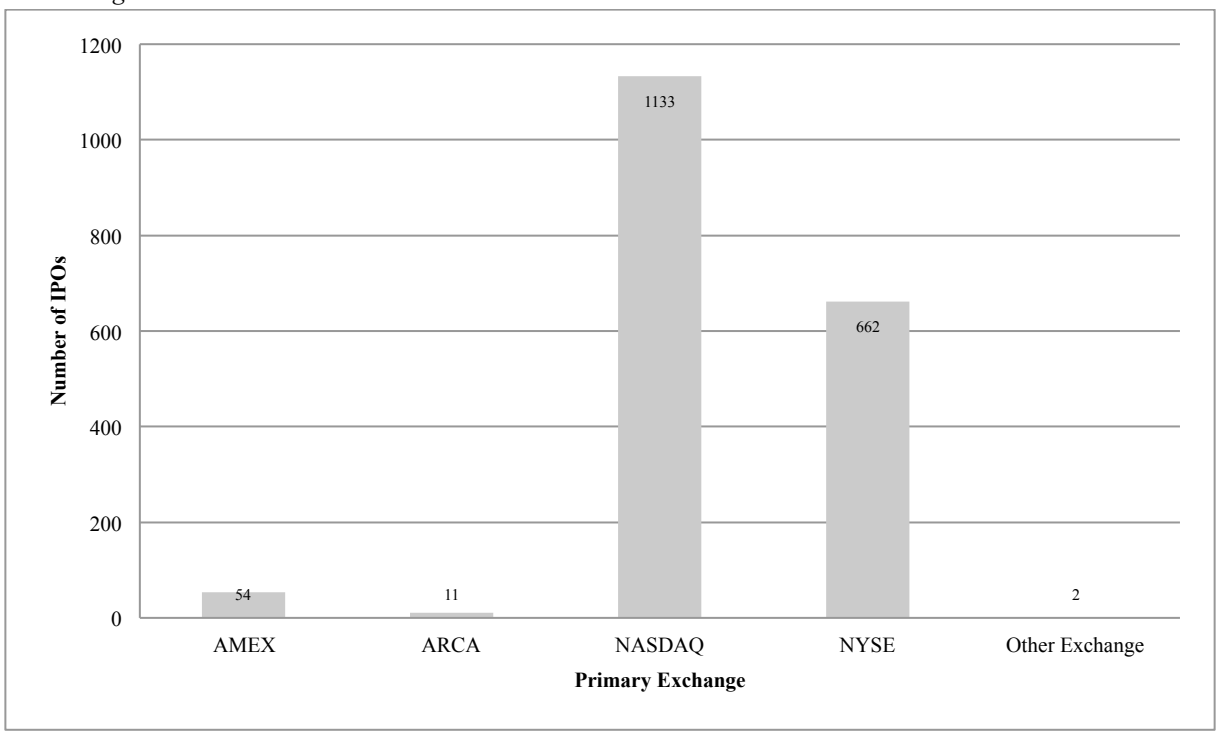
		Mean			*Median*		
Industry Division	Number of IPOs	Initial Return	Offer Price	Closing Price	Initial Return	Offer Price	Closing Price
Construction	13	7.10%	$16.08	$17.28	4.69%	$16.00	$16.75
Finance, Insurance & Real Estate	247	9.39%	$16.68	$18.62	4.18%	$16.00	$17.49
Manufacturing	539	18.45%	$13.41	$16.51	7.50%	$13.00	$14.08
Mining	97	5.86%	$17.66	$18.77	3.42%	$18.00	$18.21
Public Administration	293	14.16%	$13.43	$15.65	5.31%	$13.00	$14.00
Retail Trade	74	16.31%	$15.31	$18.17	11.05%	$16.00	$17.50
Services	411	20.80%	$14.38	$17.99	13.24%	$14.00	$16.50
Transportation & Public Utilities[29]	158	8.11%	$16.92	$18.38	3.76%	$17.00	$17.68
Wholesale Trade	30	7.02%	$14.78	$15.93	5.18%	$13.00	$14.87
All	1862	15.21%	$14.70	$17.32	6.68%	$14.00	$15.59

Figure III shows the number of IPOs listed on each exchange for the period 2000-2013. The AMEX, the ARCA, the NASDAQ, and the NYSE represent 3%, 1%, 61%, and 35% of the IPOs respectively.

[29] An abridged version of the classification Transportation, Communications, Electric, Gas & Sanitary Services.

Figure III
IPOs among Exchanges

The sample consists of 1862 US IPOs for 2000-2013 with an offer price of at least $3.00. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP). The primary exchange on which the security is traded is set along the horizontal axis. The number of IPOs listed on each exchange (bars) is set along the vertical axis.



4.2 Regression analyses

In order to perform regression analyses I distract 1857 out of the earlier described 1862 IPOs, by excluding IPOs with missing values on at least one of the variables described in the previous chapter. Table V reports the regression results, whereby initial returns are regressed on 7 different explanatory variables, including the control variable (i.e. offer price, issue size or market capitalization, age of the company, reputation of the underwriter, primary exchange, roll-up companies, and return on the S&P 500 index).

Note that I treat issue size and market capitalization as mutually exclusive inputs, to avoid the problem of multicollinearity. As the quantity components of both variables are the same on the first day of trading, both predictors tend to move together (i.e. show a high level of correlation).

Table V
Regression Results – Initial Returns

*The sample consists of 1857 US IPOs for 2000-2013 with an offer price of at least $3.00 and complete data on all variables is available, including overpriced, correctly priced, and underpriced IPOs. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP), the Field-Ritter dataset of company founding dates and the dataset on IPO Underwriter Reputation Rankings by Professor Jay Ritter, which builds on the Carter and Manaster (1990) methodology of ranking underwriters. The dependent variable in both regressions is the initial return, calculated as the percentage change from the offer price to the closing price on the first day. The offer price is the natural logarithm of the price at which new issued stock is offered to the public, expressed in US $. The issue size is the natural logarithm of the number of shares offered multiplied by the offer price, expressed in US $ (taking the natural logarithm after multiplication of non-logarithm values). The market capitalization is the natural logarithm of the number of shares offered multiplied by the market price at the end of the first day, expressed in US $ (taking the natural logarithm after multiplication of non-logarithm values). The age of the company is the natural logarithm of the age of the company plus one, before going public. The underwriter reputation dummy takes a value of one if the underwriter is ranked 8 or higher during the year of the deal (zero otherwise). The primary exchange dummy takes a value of one if the security is traded on the NASDAQ (zero otherwise). The roll-up dummy takes a value of one is the company is primarily built by acquiring smaller companies in the same industry (zero otherwise). The return on the S&P 500 Index is the percentage return on the market on the day of the IPO. Under the estimated coefficients of the explanatory variables, the t-statistics are given between parentheses. *, **, And *** indicate significance at a 10%, 5%, and 1% level respectively.*

Independent variable	[1]	[2]
Constant	-0.651	-1.799
	(-4.70)***	(-14.09)***
Offer Price	0.187	0.082
	(8.87)***	(3.94)***
Issue Size	0.012	-
	(1.53)	
Market Capitalization	-	0.086
		(11.39)***
Age Company	-0.015	-0.021
	(-2.36)**	(-3.50)***
Underwriter Reputation	0.037	-0.011
	(2.03)**	(-0.64)
Primary Exchange	0.123	0.136
	(8.60)***	(9.91)***
Roll-up	-0.077	-0.080
	(-1.15)	(-1.24)
Return on S&P 500 Index	-0.552	-0.258
	(-0.80)	(-0.39)
N	1857	1857
Adjusted R^2	0.088	0.147

In the first column of table V I regress the initial returns of, in total, 1857 US IPOs on offer prices, issue sizes, age of the companies, reputation of the underwriters, primary exchanges, and roll-up companies whereby controlling for the returns on the S&P 500 index, all measured during the first day of trading.

The results of the first regression show that offer price, underwriter reputation, and primary exchange are positively significant related to the level of underpricing, on a respectively, 0.01, 0.05, and 0.01 level. Meaning that a one percent increase in offer price results, on average, in a 0.187% increase in underpricing. The coefficients of underwriter reputation and primary exchange respectively indicate that deals underwrote by prestigious underwriters had, on average, 3.7% higher initial returns than deals underwrote by less prestigious underwriters and IPOs listed on the NASDAQ experience, on average, 12.3% higher initial returns than IPOs listed on other exchanges. The results also show that the age of the company is negatively significant related to the level of underpricing, on a 0.05 level. The coefficient tells us that a one percent increase in age leads, on average, to a 0.015% decrease in the level of underpricing. However, there is no evidence for issue size and roll-ups to be related to underpricing.

The total model is significant and the adjusted R^2 of 0.088 implies that 8.8% of the variation in the initial returns is explained by the model (i.e. the explanatory variables). Under the assumption that the sources of information asymmetry are correctly covered by the explanatory variables, the model argues that the vast majority (i.e. 91.2%) of the variation in underpricing is explained by factors other than asymmetric information. This is confirmed by the significance level of the constant term.

In the second column of table V I regress the initial returns of, in total, 1857 US IPOs on offer prices, market capitalization, age of the companies, reputation of the underwriters, primary exchanges, and roll-up companies whereby controlling for the returns on the S&P 500 index, all measured during the first day of trading.

The results of the second regression show that offer price, market capitalization, and primary exchange are positively significant related to the level of underpricing, all on 0.01 levels. Meaning that a one percent increase in offer price and market capitalization respectively result, on average, in a 0.082% and a 0.086% increase in underpricing. The coefficient of the primary exchange indicates that IPOs listed on the NASDAQ experience, on average, 13.6% higher initial returns than IPOs listed on other exchanges. The results also show that the age of the company is negatively significant related to the level of underpricing, on a 0.01 level. The coefficient tells us that a one percent increase in age leads, on average, to a 0.021% decrease in the level of underpricing. However, there is no evidence for roll-ups to be related

to underpricing and the reputation of the underwriter becomes insignificant after the addition of market capitalization.

The total model is again significant and the adjusted R^2 rises to 0.147, after adding market capitalization to the model, implying that 14.7% of the variation in the initial returns is explained by the model (i.e. the explanatory variables). Under the assumption that the sources of information asymmetry are correctly covered by the explanatory variables, the model argues that still the vast majority (i.e. 85.3%), although smaller, of the variation in underpricing is explained by factors other than asymmetric information. This is confirmed by the significance level of the constant term.

To test whether these results are different for pure underpriced IPOs, I divide the sample into three different groups. The overpriced, correctly priced, and underpriced IPOs[30]. Of the 1857 IPOs, 397 are overpriced, 138 are correctly priced, and 1322 are underpriced. The mean value of overpricing is 6.53% and the mean value of underpricing is 23.36%[31]. The aim of this procedure is to test whether the independent variables are better explaining the underpricing phenomenon for pure underpriced IPOs, in comparison to the model that contains all groups (i.e. the overpriced, correctly priced and underpriced IPOs).

Table VI reports the regression results for the underpriced IPOs, whereby initial returns are regressed on 7 different explanatory variables, including the control variable (i.e. offer price, issue size or market capitalization, age of the company, reputation of the underwriter, primary exchange, roll-up companies, and return on the S&P 500 index). Note again that I treat issue size and market capitalization as mutually exclusive inputs, to avoid the problem of multicollinearity.

In the first column of table VI I regress the initial returns of, in total, 1322 underpriced US IPOs on offer prices, issue sizes, age of the companies, reputation of the underwriters, primary exchanges, and roll-up companies whereby controlling for the returns on the S&P 500 index, all measured during the first day of trading.

[30] Note that this partially follows the reasoning of Yan (2010) who separates initial returns in components of underpricing and overpricing, with their own accompanying determinants.
[31] This follows the same methodology as before but the calculations are based on respectively 397 solely overpriced and 1322 solely underpriced IPOs.

Table VI
Regression Results – Underpriced IPOs

*The sample consists of 1322 underpriced US IPOs for 2000-2013 with an offer price of at least $3.00 and complete data on all variables is available. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP), the Field-Ritter dataset of company founding dates and the dataset on IPO Underwriter Reputation Rankings by Professor Jay Ritter, which builds on the Carter and Manaster (1990) methodology of ranking underwriters. The dependent variable in both regressions is the initial return, calculated as the percentage change from the offer price to the closing price on the first day. The offer price is the natural logarithm of the price at which new issued stock is offered to the public, expressed in US $. The issue size is the natural logarithm of the number of shares offered multiplied by the offer price, expressed in US $ (taking the natural logarithm after multiplication of non-logarithm values). The market capitalization is the natural logarithm of the number of shares offered multiplied by the market price at the end of the first day, expressed in US $ (taking the natural logarithm after multiplication of non-logarithm values). The age of the company is the natural logarithm of the age of the company plus one, before going public. The underwriter reputation dummy takes a value of one if the underwriter is ranked 8 or higher during the year of the deal (zero otherwise). The primary exchange dummy takes a value of one if the security is traded on the NASDAQ (zero otherwise). The roll-up dummy takes a value of one is the company is primarily built by acquiring smaller companies in the same industry (zero otherwise). The return on the S&P 500 Index is the percentage return on the market on the day of the IPO. Under the estimated coefficients of the explanatory variables, the t-statistics are given between parentheses. *, **, And *** indicate significance at a 10%, 5%, and 1% level respectively.*

Independent variable	[1]	[2]
Constant	-0.427	-1.644
	(-2.46)**	(-10.05)***
Offer Price	0.197	0.085
	(7.39)***	(3.21)***
Issue Size	0.003	-
	(0.34)	
Market Capitalization	-	0.081
		(8.43)***
Age Company	-0.034	-0.039
	(-4.17)***	(-4.88)***
Underwriter Reputation	0.078	0.027
	(3.28)***	(1.16)
Primary Exchange	0.140	0.154
	(7.72)***	(8.76)***
Roll-up	-0.120	-0.109
	(-1.50)	(-1.39)
Return on S&P 500 Index	-1.166	-0.714
	(-1.33)	(-0.84)
N	1322	1322
Adjusted R^2	0.096	0.143

The results of the first regression show that offer price, underwriter reputation, and primary exchange are positively significant related to the level of underpricing, all on 0.01 levels. Meaning that a one percent increase in offer price results, on average, in a 0.197% increase in underpricing. The coefficients of underwriter reputation and primary exchange respectively

indicate that deals underwrote by prestigious underwriters had, on average, 7.8% higher initial returns than deals underwrote by less prestigious underwriters and IPOs listed on the NASDAQ experience, on average, 14.0% higher initial returns than IPOs listed on other exchanges. The results also show that the age of the company is negatively significant related to the level of underpricing, on a 0.01 level. The coefficient tells us that a one percent increase in age leads, on average, to a 0.034% decrease in the level of underpricing. However, there is no evidence for issue size and roll-ups to be related to underpricing.

The total model is significant and the adjusted R^2 of 0.096 implies that 9.6% of the variation in the initial returns is explained by the model (i.e. the explanatory variables). Under the assumption that the sources of information asymmetry are correctly covered by the explanatory variables, the model argues that the vast majority (i.e. 90.4%) of the variation in underpricing is explained by factors other than asymmetric information. This is confirmed by the significance level of the constant term.

In the second column of table VI I regress the initial returns of, in total, 1322 underpriced US IPOs on offer prices, market capitalization, age of the companies, reputation of the underwriters, primary exchanges, and roll-up companies whereby controlling for the returns on the S&P 500 index, all measured during the first day of trading.

The results of the second regression show that offer price, market capitalization, and primary exchange are positively significant related to the level of underpricing, all on 0.01 levels. Meaning that a one percent increase in offer price and market capitalization respectively result, on average, in a 0.085% and a 0.081% increase in underpricing. The coefficient of the primary exchange indicates that IPOs listed on the NASDAQ experience, on average, 15.4% higher initial returns than IPOs listed on other exchanges. The results also show that the age of the company is negatively significant related to the level of underpricing, on a 0.01 level. The coefficient tells us that a one percent increase in age leads, on average, to a 0.039% decrease in the level of underpricing. However, there is no evidence for roll-ups to be related to underpricing and the reputation of the underwriter becomes insignificant after the addition of market capitalization.

The total model is again significant and the adjusted R^2 rises to 0.143, after adding market capitalization to the model, implying that 14.3% of the variation in the initial returns is

explained by the model (i.e. the explanatory variables). Under the assumption that the sources of information asymmetry are correctly covered by the explanatory variables, the model argues that still the vast majority (i.e. 85.7%), although smaller, of the variation in underpricing is explained by factors other than asymmetric information. This is confirmed by the significance level of the constant term.

For the first two models, in which I use all IPOs for regression, the question raises whether the share of underpriced IPOs (1322 out of 1857) influences the explanatory power of the model. The last two models try to solve this concern by reducing the sample size towards a total of 1322 solely underpriced IPOs. The results of all models do show the relationship between measures of information asymmetry and the level of underpricing, in the broader sense[32]. However, the models do not provide enough evidence to conclude that the sources of information asymmetry are only or better explaining underpricing, as the models have more or less the same explanatory power. Do note that the age of the company and the underwriter reputation become more important determinants in terms of coefficient and the accompanying significance level, for model 3 in comparison with model 1.

As there seems to be interaction between measures of information asymmetry and the phenomena of both underpricing and overpricing, I use the second model to investigate whether the decrease in initial returns after the Internet Bubble of 1999-2000 is explained by the explanatory variables in this research[33]. Building upon the method of Loughran and Ritter (2004), I create dummy variables for IPOs occurred during the Post-Internet Bubble period (2001-2007), during the crisis of 2008, and during the aftermath of the crisis (2009-2013). Recall that the level of underpricing peaked during the Internet Bubble of 2000 and reached the lowest point during the crisis of 2008. Table VII reports the regression results, whereby initial returns are regressed on 10 different explanatory variables, including the control variable (i.e. offer price, market capitalization, age of the company, reputation of the underwriter, primary exchange, roll-up companies, Post-Internet Bubble dummy, Crisis dummy, Post-Crisis dummy, and return on the S&P 500 index).

[32] Meaning that the majority of the proxies of information are related to the initial returns of underpriced, as well as correctly priced, and overpriced IPOs.

[33] Note that I use the model including market capitalization, as this model exhibits the highest explanatory power.

Table VII
Regression Results – Initial Returns

*The sample consists of 1857 US IPOs for 2000-2013 with an offer price of at least $3.00 and complete data on all variables is available, including overpriced, correctly priced, and underpriced IPOs. ADRs, foreign incorporated companies, unit offers, REITS, closed-end funds, and IPOs not listed on CRSP are excluded. Information is obtained from the Center for Research in Security Prices (CRSP), the Field-Ritter dataset of company founding dates and the dataset on IPO Underwriter Reputation Rankings by Professor Jay Ritter, which builds on the Carter and Manaster (1990) methodology of ranking underwriters. The dependent variable in the regression is the initial return, calculated as the percentage change from the offer price to the closing price on the first day. The offer price is the natural logarithm of the price at which new issued stock is offered to the public, expressed in US $. The market capitalization is the natural logarithm of the number of shares offered multiplied by the market price at the end of the first day, expressed in US $ (taking the natural logarithm after multiplication of non-logarithm values). The age of the company is the natural logarithm of the age of the company plus one, before going public. The underwriter reputation dummy takes a value of one if the underwriter is ranked 8 or higher during the year of the deal (zero otherwise). The primary exchange dummy takes a value of one if the security is traded on the NASDAQ (zero otherwise). The roll-up dummy takes a value of one is the company is primarily built by acquiring smaller companies in the same industry (zero otherwise). The return on the S&P 500 Index is the percentage return on the market on the day of the IPO. The Post-Internet Bubble dummy takes a value of one if the IPO occurred during 2001-2007 (zero otherwise). The Crisis dummy takes a value of one if the IPO occurred during the start of the crisis in 2008 (zero otherwise). The Post-Crisis dummy takes a value of one if the IPO occurred after 2008 (zero otherwise). Under the estimated coefficients of the explanatory variables, the t-statistics are given between parentheses. *, **, And *** indicate significance at a 10%, 5%, and 1% level respectively.*

Independent variable	[1]
Constant	-1.441
	(-11.13)***
Offer Price	0.100
	(4.94)***
Market Capitalization	0.076
	(10.15)***
Age Company	-0.015
	(-2.46)**
Underwriter Reputation	-0.029
	(-1.63)
Primary Exchange	0.106
	(7.62)***
Roll-up	-0.079
	(-1.26)
Post-Internet Bubble	-0.205
	(-9.86)***
Crisis	-0.296
	(-5.40)***
Post-Crisis	-0.196
	(-8.89)***
Return on S&P 500 Index	-0.142
	(-0.22)
N	1857
Adjusted R^2	0.192

The regression in table VII extends the second regression of table V. I regress the initial returns of, in total, 1857 US IPOs on offer prices, market capitalization, age of the companies, reputation of the underwriters, primary exchanges, roll-up companies, and time-dummies whereby controlling for the returns on the S&P 500 index. As the vast majority of the conclusions remain unchanged, the explanatory power of the significant model rises to 0.192. This number indicates that 19.2% of the variation in the initial returns is explained by the model. The coefficients of the time-dummies tell us that the decrease of underpricing after 2000 is only for a small part explained by the explanatory variables. The decrease in underpricing from the Internet Bubble of 2000 to the Post-Internet Bubble period is explained for about 20% by the model. The same holds for the decrease in underpricing from the Internet Bubble to the Post-Crisis period[34]. The decrease in underpricing from the Internet Bubble to the Crisis of 2008 is explained for about 30% by the model.

4.3 Hypotheses analysis

The inferences of the preceding section lead to the acceptance of hypotheses 2, 3, and 6. All regressions show a positive significant relationship between the market capitalization and the level of underpricing, a negative significant relationship between the age of the company and the level of underpricing, and a significant influence of NASDAQ-listed stocks. Indicating that companies which decide to go public, having a high market capitalization, experience on average higher levels of underpricing, older companies which decide to go public experience on average less underpricing and IPOs listed on the NASDAQ are on average confronted with more underpricing in comparison to other exchanges (AMEX, ARCA, and NYSE). However, none of the regressions show evidence for issue size to be related to underpricing. Besides the mixed results on underwriter reputation militate for not accepting the hypothesis. Lastly, the time-dummies show admittedly significant results, but their explanatory power is negligible.

[34] Note that I use the average initial return of 2001-2007 and 2009-2013 for respectively the level of underpricing during the Post-Internet Bubble period and the Post-Crisis period by assigning equal weights to each IPO.

5 Discussion

According to Loughran and Ritter (2004), reasons for underpricing vary across time and environment[35]. In this research I test whether information asymmetry fulfills a role in underpricing for the period after the Internet Bubble of 1999-2000 (i.e. 2000-2013). For this period I find that several proxies for information asymmetry have an explanatory power on the variation in underpricing for the US IPO market and so it is conceivable that information asymmetry fulfills a role in today's underpricing.

As proxies for information asymmetry, the majority of the results on the variables argue that information asymmetry affects underpricing in today's IPO market. The results of the regressions show that offer price, market capitalization, age of the company, and the exchange on which the stock is listed have a significant impact on the level of underpricing. Under the assumption that information asymmetry is translated well into these proxies, the relationships, both positive and negative, indicate that information asymmetry affects underpricing in today's IPO market. Issue size seems to have no impact on the level of underpricing as well as the reputation of the underwriter. This is an indication that not all proxies for information asymmetry are explaining underpricing in the current IPO market.

I find a positive significant relationship between the offer price and the level of underpricing. This result tells us that offer price, as a proxy for information asymmetry, plays an important role in today's underpricing. Indicating that companies, which offer stock at a higher price, experience on average higher levels of underpricing. This contradicts the view of Allen and Faulhaber (1989) who argue that high quality firms signal their prospects by lowering the offer price to inform the investor that the firm is able to carry the costs of underpricing (i.e. creating underpricing). However, one plausible explanation for this relationship is that the degree of uncertainty on share value is relatively big for high-priced shares in comparison to low-priced shares, which results in higher levels of underpricing for shares with a relatively high offer price, as underpricing ultimately compensates for risk.

[35] Note that Loughran and Ritter (2004) argue that information asymmetry is the main reason for underpricing in the US in the 1980s but not during the Internet Bubble of 1999-2000.

Besides I find a positive significant relationship between market capitalization and the level of underpricing. This result tells us that market capitalization, as a proxy for information asymmetry, plays an important role in today's underpricing. Indicating that companies, which decide to go public having a high market capitalization, experience on average higher levels of underpricing. Companies, with a high market capitalization are often seen as high quality companies, which are able to carry the costs of underpricing. This is line with the earlier findings of Boubaker and Mezhoud (2011) and Bundoo (2007) who argue that market capitalization is a signal to inform the investor about the quality of the company.

I observe a negative significant relationship between the age of the company and the level of underpricing. This result tells us that age of the company, as a proxy for information asymmetry, plays an important role in today's underpricing. Indicating that older companies, which decide to go public, experience on average less underpricing. Younger companies face bigger ex ante uncertainty and are confronted with higher levels of underpricing. This is line with Ritter (1991) who argues that older companies have more information available which, in turn, helps to reduce information asymmetry.

Moreover, I observe a significant influence of NASDAQ-listed stocks. Indicating that IPOs listed on the NASDAQ are on average confronted with more underpricing in comparison to other exchanges (AMEX, ARCA, and NYSE). This result shows that the listing market is able to affect the level of underpricing, as suggested by Uddin (2001). However, the proxies for information asymmetry are held constant, implying that there is no reason to assume that the NASDAQ Stock Market is confronted with higher levels of underpricing because of asymmetric information. The most reasonable explanation for this finding is the accumulation of technology stocks[36] on the NASDAQ Stock Market, in particular during the Internet Bubble period.

However, I could not find evidence for issue size and reputation of the underwriter to be related to the level of underpricing. Implying that information asymmetry, included in these variables, is not explaining underpricing for today's IPO market.

[36] Note that technology stocks are confronted with higher levels of underpricing (*see univariate sorts of table III*).

By analysing a range of prominent models based on information asymmetry between the different participants of the IPO process, i.e. the investors, the issuers, and the investment bankers I find that the majority of the proxies for information asymmetry are related to underpricing in the IPO market of today. According to the results of the regressions, information asymmetry is responsible for about 10-20% of the variation in today's underpricing, indicating that information asymmetry fulfills a modest but important role in the underpricing of today. I also find that the decrease of underpricing after the Internet Bubble of 1999-2000 is only for a small part explained by a change in the degree of information asymmetry.

6 Conclusion

This paper examines the anomaly of short-term underpricing in the IPO market. Strengthened by the disagreement about theories explaining the anomaly of underpricing, this paper aims to investigate the role of information asymmetry in underpricing for today's market, resulting in the following research question: What is the impact of information asymmetry on underpricing in the IPO market?

As theories around information asymmetry fulfill a central role in a broad range of theories around underpricing, this study analyses a range of prominent models based on information asymmetry between the different participants of the IPO process, i.e. the investors, the issuers, and the investment bankers.

By using data on 2350 US IPOs, from 2000 until 2014, I first perform an initial return analysis for the US IPO market. I observe an average level of underpricing of 13.45% with a peak during the Internet Bubble in 2000 of 35.56% and a trough during the crisis of 2008 of 2.32%. I also show that Services and Manufacturing industries are important contributors to the IPO market in terms of number of IPOs and in terms of high initial returns. Lastly, I observe that a majority of the IPOs are listed on the NASDAQ.

Building on the inferences of the theories around asymmetric information, I use different sources of information asymmetry to test whether these are related to underpricing. I perform several regressions by using different proxies for information asymmetry and find that information asymmetry plays a modest role in today's underpricing. I show that offer price and market capitalization are positively related to underpricing. I also show that NASDAQ-listed stocks have a significant influence on the level of underpricing in comparison to AMEX-, ARCA-, and NYSE-listed stocks and that the age of the company is negatively related to underpricing. The regression results present no evidence for issue size to be related to underpricing, as well as underwriter reputation. Lastly, there is no evidence that roll-up companies experience more or less underpricing than other companies.

This paper presents evidence that information asymmetry, assumed to be correctly covered by the proxies for information asymmetry, is to some extent related to underpricing. I show that

information asymmetry is responsible for about 10-20% of the variation in the underpricing for today's IPO market. I also show that the decrease in underpricing after the Internet Bubble of 1999-2000 is for a small part explained by the problem of information asymmetry.

7 References

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Appendix

Table A.1 gives an enumeration of high-prestige underwriters during the 2000-2014 period.

Table A.1
High-Prestige Underwriters

Comprehensive list of underwriters that were ranked 8 or higher in at least one sub-period (between 2000-2014).

ABD Securities	ABN AMRO Chicago Corp
ABN AMRO Inc.	ABN AMRO Rothschild
ABN-AMRO Holding NV	Alex Brown & Sons Inc.
Allen & Co Inc.	Banc of America Securities LLC
Bank of America-Merrill Lynch	BancAmerica Robertson Stephens
BancBoston Robertson Stephens	Banque Nationale de Paris (BNP)
Banque Paribas Capital Markets	Barclays Capital
Barclay Investments Inc.	Bear Stearns & Co Inc.
Bear Stearns Int.	BT Alex Brown Inc.
Cazenove & Co	Cazenove Inc.
Charles Schwab & Co Inc.	Chase H&Q
Chase Manhattan Bank NA	Chase Securities Inc.
CIBC Oppenheimer	CIBC Wood Gundy Securities
CIBC World Markets	Citicorp Securities Inc.
Citigroup	Citigroup Global Markets Inc.
Citigroup/Salomon Smith Barney	Credit Suisse FB (Europe)
Credit Suisse First Boston	Credit Suisse First Boston Int.
CS First Boston	Dai-Ichi Kangyo Bank
Daiwa Securities	Daiwa Securities (New York)
Daiwa Securities America	Dean Witter
Dean Witter Distributors Inc.	Dean Witter Reynolds Inc.
Deutsche Banc Alex Brown	Deutsche Bank AG
Deutsche Bank AG (London)	Deutsche Bank AG (New York)
Deutsche Bank Securities Corp	Deutsche Morgan Grenfell
Dillon, Read & Co Inc.	DKB Securities Co Ltd
DLJ direct	Donaldson Lufkin & Jenrette
First Boston Corp	FleetBoston Robertson Step Int.
Goldman Sachs & Co	Goldman Sachs Asia
Goldman Sachs Int.	Hambrecht & Quist
HSBC	HSBC Investment Banking Ltd
HSBC James Capel & Co	HSBC Securities Inc.
Jefferies & Co Inc.	JP Morgan (JPM)
JP Morgan Securities Inc.	Kidder Peabody & Co Inc.

Kleinwort Benson North America
Lazard
Lazard Freres & Co LLC
Lazard Houses
Lehman Brothers Int.
Merrill Lynch & Co Inc.
Merrill Lynch Int.
Merrill Lynch, Pierce, Fenner
Morgan Stanley
Morgan Stanley Dean Witter
Nations Banc Montgomery Sec
Nomura Int. Ltd
Nomura Securities
Oppenheimer & Co Inc.
PaineWebber Int.
Prudential Volpe Technology Gr
Robertson Stephens & Co
Salomon Smith Barney
Sandler O'Neill Partners
Santa Barbara Securities
SBC Warburg
SBCI Swiss Bank Corp Investment Banking
Schroder Salomon Smith Barney
Shearson Lehman Brothers
Smith Barney Shearson
Thomas Weisel Partners LLC
UBS AG
UBS Ltd
UBS Warburg
Warburg Dillon Read
Wells Fargo
Yamaichi Int. (America) Inc.

Kleinwort Benson Securities
Lazard Capital Markets
Lazard Freres et Cie
Lehman Brothers
Mediobanca
Merrill Lynch Far East Ltd
Merrill Lynch Private Ltd Sing
Montgomery Securities
Morgan Stanley & Co
Morgan Stanley Int.
NatWest Securities
Nomura Securities Int.
Nomura Securities New York Inc.
PaineWebber
Prudential Vector Healthcare
RBC Capital Markets
Salomon Brothers
Salomon Smith Barney Int.
Sanford C Bernstein & Co Inc.
Santander Investment Bank
SBC Warburg Dillon Read Inc.
Schroder & Co Inc.
Schroder Wertheim & Co
Smith Barney Inc.
Smith Barney, Harris Upham
UBS
UBS Investment Bank
UBS Securities Inc.
Union Bank of Switzerland
Wasserstein Perella Securities
Wertheim Schroder