The effect of underwriter prestige on German IPO short- and long-run performance

---

ERASMUS UNIVERSITY ROTTERDAM

ERASMUS SCHOOL OF ECONOMICS

MSc Financial Economics

Master Thesis

Name student: Jaap Ouborg

Student ID number: 547834

Supervisor: Stefan Obernberger | Erasmus School of Economics

Second assessor: Jan Lemmen | Erasmus School of Economics

Date final version: 30/08/2020

Acknowledgements

I would like to express great gratitude to Stefan Obernberger for the guidance he has provided to me while I was in the process of writing my thesis. Writing this Master thesis was a long journey and educational experience in which I would not have succeeded without the support and guidance of him. Furthermore, I would like to thank Daniel Bias who has provided me with the data on German IPOs. This data allowed me to fulfill the required empirical research. Last, I want to thank my family and friends for supporting me during the whole process of writing this thesis.

Abstract

This MSc thesis examines the impact of underwriter prestige on IPO short- and long-run performance in the German stock market over the period 1985 to 2015. I use two alternative underwriter prestige measures based on either the ratio of the total gross proceeds raised by an underwriter or the number of IPOs underwritten by each underwriter. A sample of 442 IPOs is used to conduct various OLS regression analyses. I find that underwriter prestige has a significant impact on both the initial underpricing and the long-run performance of German IPOs. However, when I divide the two different prestige measures into three prestige groups, low, medium and high, the relation not significant. The same occurs when comparing the six largest underwriters with the others.

Table of Contents

1.Introduction

This thesis aims to answer the following central question: *"Does underwriter prestige impact the short- and long-run performance of German IPOs?"*. This thesis correspondingly focuses on the impact of underwriter prestige on initial IPO underpricing and long-run performance in Germany from 1985 until 2015. This thesis will contribute to the existing literature. It sheds further light on the theory that more prestigious underwriters are associated with lower initial underpricing effect and less severe long-run underperformance. Moreover, to the best of my knowledge, this thesis is the first to study the impact of underwriter prestige on the short- and long-run performance in Germany from 1985 until 2015.

An Initial Public Offering (IPO) is a way for private companies to raise capital, next to debt placements with banks and contributions of their owners, to grow. Large and established companies, such as Saudi Aramco, Visa Inc., and Facebook, have grown massively due to their IPOs. When investing in an IPO, there are two essential aspects of the price performance of companies that emerge: initial underpricing effect and long-run underperformance (Ritter, 1984; Beatty and Ritter, 1986; Ritter, 1991; Ritter and Welch, 2002).

Throughout an IPO's process, the underwriter plays an essential role as information middlemen to mitigate information asymmetry between companies and external investors. They provide essential services, such as certification of the IPO value, pricing of the shares, marketing of the shares, and monitoring during and after the IPO process. When choosing an
underwriter, this is based on a variety of factors, such as expertise in a specific industry, relations in the financial world, and the prestige. The level of prestige can have an impact on the performance of an IPO.

Previously empirical and theoretical studies, such as Beatty and Ritter (1986), Carter et al. (1998), Carter and Manaster (1990), Chemmanur and Fulghieri (1994), and, Johnston and Roten (2015), have examined the impact of underwriter prestige on the initial underpricing effect. Beatty and Ritter (1986) show that more prestigious underwriters tend to underwrite low-risk IPO companies to reduce the level of underpricing in order to attract more investors. Likewise, Carter et al. (1998) and Carter and Manaster (1990) report a negative relation between the underwriter prestige and the initial underpricing effect. More established IPO companies select underwriters with more prestige, as this sends a good signal to external investors. Furthermore, Chemmanur and Fulghieri (1994) argue that IPO companies can communicate the right messages to the investors during the underwriter selection process, as more prestigious underwriters carefully decide the IPOs they want to manage to avoid damage to their reputational capital. However, Johnston and Roten (2015) show a positive relationship

between the underwriter prestige and the initial underpricing effect, indicating that IPOs underwritten by more prestigious underwriters have higher levels of initial underpricing effect. This relationship changed from negative to positive around 1993, due to payment for analyst coverage through increasing initial returns by IPO companies. Likewise, Cliff and Dennis (2004) present consistent evidence that the more prestigious the underwriter, the higher the aftermarket's initial returns.

Underwriters impact the short-run aftermarket price and the long-run IPO performance by actively participating in aftermarket trades. Carter et al. (1998) were the first to examine the relation between underwriter prestige and the long-run IPO underperformance by comparing the evaluation of three different underwriter prestige measures of Johnson and Miller (1988), Carter and Manaster (1990) and, Megginson and Weiss (1991). Johnson and Miller (1988) developed a four-tier underwriter prestige measure by allocating an underwriter prestige ranking variable from 0 till 3 to each underwriter, meaning three is for the most prestigious underwriters. Furthermore, Megginson and Weiss (1991) measure underwriter prestige based on the relative market share of all IPOs managed by each underwriter. The most significant measure is that of Carter and Manaster (1990), they compare underwriter positions in stock offerings as 'tombstone announcements' and allocate an underwriter prestige ranking variable from zero to nine to each underwriter, nine is for the most prestigious underwriters. In the study of Carter et al. (1998), they show a reduced amount of the negative relation between underwriter prestige and the long-run performance, indicating that more prestigious underwriters mitigate the underperformance of IPOs. In addition, Chemmanur and Fulghieri (1994) show that more prestigious underwriters select individual IPO companies, which perform better in the long-run, to protect their reputational capital and maintain their status as having the ability to separate quality companies from 'lemons' and, therefore, the relationship is positive between the underwriter prestige and long-run IPO performance.

The impact of more prestigious underwriters and their support services in minimizing the initial underpricing effect and positively influencing the long-run IPO performance of IPOs is well-documented in the theoretical and empirical literature on the American stock market. Nonetheless, evidence of this impact in the European stock markets is scarce. Loughran et al. (1994) examine the initial underpricing effect and the long-run IPO performance of several countries in Europe in comparison to the American IPOs. They show that the initial underpricing of IPOs in almost every European country is higher when being compared to American IPOs, excluding Italy. However, the long-run performance is less severe in Sweden, the United Kingdom, and in Germany. Moreover, Ljunqvist (1997) shows evidence of the high underpricing effect and long-run underperformance of

German IPOs from 1970 until 1993. Even so, the impact of the underwriter prestige is scarce examined in Europe and, especially, in Germany.

In this thesis, I follow the methodology of Johnson and Miller (1988) to calculate the initial returns which looks at the percentage difference between the first trading day closing price and the offering price. Afterwards, I adjust the initial returns with appropriate market index which is the DAX. Furthermore, I calculate the long-run performance by computing the BHAR which looks at buying the IPO share at the first trading day closing price and selling it after a three-year period compared to the appropriate market index. The foremost advantage of selecting a market index as a benchmark is that there is no subjective interference on the composition of the benchmark portfolio. Moreover, to calculate the underwriter prestige I use two different measures based on the methodology of Megginson and Weiss (1991). The first prestige measure, from now on called 'Prestige_GrossProceeds', is based on the assumption that the higher the gross proceeds raised by an underwriter, the higher the underwriter prestige. The underwriter prestige is measured as the ratio of the total gross proceeds raised by the underwriter to the entire gross proceeds raised in my sample. The second prestige measure, from now on called 'Prestige_IPOs', assumes that the more IPOs an underwriter has managed, the higher the underwriter prestige. The underwriter prestige is measured as the total of all IPOs managed by the underwriter in my sample. Afterwards, I divide the two different measures into three prestige groups, low, medium and high, according to the methods of Johnson and Miller (1988).

Conclusively, I find that there is a severe initial underpricing and long-run underperformance of German IPOs compared to the market index, consistent with previous studies (Ljungqvist, 1997; Carter et al., 1998). Additionally, in the regression analyses, the underwriter prestige measure (UR1) shows a significant negative relation with initial underpricing and significant positive relationship with long-run performance, indicating that investors who hold German IPOs reduce their risks when investing in IPOs underwritten by more prestigious underwriters. However, the explanatory power is low, as many relations were insignificant when dividing the IPOs into sub-samples based on low, medium, and high prestige.

This thesis is structured as followed: *Section 2* assesses the existing literature and hypotheses development. *Section 3* describes the data used in the analysis. *Section 4* discusses the method employed. *Section 5* present the empirical results. The thesis is brought to a close with the conclusion and discussion in *Section 6*.

2. Literature Review

To understand the theories examined in this thesis, it is essential to provide you with the definition and necessary background information of Initial Public Offerings (IPOs) and the role of underwriters.

An Initial Public Offering (IPO) defines the first time that a company sells its shares to the general public on a stock exchange (Carter & Manaster, 1990). After such a moment, a company is listed in the stock market. An IPO can be the first issue of equity, debt, or a combination of both securities. Naturally, a company does not issue an IPO without reason. The IPO can be used by a company for several purposes. The foremost reason for private companies to go public is to access a new financing source, this allows them to raise equity capital. In return, the founders of the company get rewarded with cash (Ritter & Welch, 2002). The accumulated equity of an IPO provides growth and business expansion and can help change the company's capital structure.

Additionally, IPOs can enhance the company's reputation and enable it to change into a potential target for acquirers. Subsequently, when a company goes public, this can help the owners to sell it for a higher price compared to a private transaction (Ritter & Welch, 2002). Public trading helps reduce the informational asymmetries between the company and the general public, allowing the company to improve the value.

When going public, a company needs to choose an underwriter that can help them with the issue. The underwriter provides services related to organizing, pricing, and selling the offering of the shares. Most of the time, the underwriter is an investment bank that can provide an initial valuation of the company based on all available information given to them. Investment bankers call this process doing due diligence (Ellis et al., 2000). The choice of a lead underwriter who can assist the company with the IPO is based on expertise in the industry, quality of the research, financial relations, and prestige. Prestige is an underwriter's track record of assisting companies in alike financial processes based on past performance. When a specific underwriter is selected, this underwriter will need to bring the issue to the general public. This underwriter will buy the number of shares offered by the IPO firm for an agreed price and sell it to the public for a slightly higher price, including specific compensation fees.

During an IPO, the underwriter is the communicator between the external investors and the IPO company. The IPO company has a relationship with the underwriter, and the underwriter has a relationship with the external investors. Thus, the underwriter and their characteristics can have an influence on the IPO process and the performance of the IPO company. One of the underwriter's first tasks is to make a thorough assessment of the IPO company's value, that is based on all the information provided by the IPO. This information is offered to the external investors in a report. The more

prestigious the underwriter is, the better the assessment of the IPO value, as more valuable information is provided for the investors (Titman & Trueman, 1986). Therefore, an IPO company will choose a more prestigious underwriter to get a better offer price.

Furthermore, the pricing of the shares is affected by the level of underwriter prestige. When an IPO company gets a better offer price due to a more prestigious underwriter, the initial return on the first trading day is lower. This difference between when the offer price is lower than the first trading day closing price is called the underpricing effect and is influenced by the level of underwriter prestige. Johnson and Miller (1988) show that more prestigious underwriters have a lower underpricing effect for the reason that IPOs issued by them tend to be less risky. These prestigious underwriters choose less risky companies as they have prestige at stake (Beatty and Ritter, 1986). When they overprice the equity issue and expectations about the company value are not met in the initial return, they will lose prestige.

Additionally, during an IPO there are risks involved which incentivize external investors to acquire more information. These external investors believe that there is a form of information asymmetry of the information they receive and the information the underwriter receives (Carter and Manaster, 1990; Rock, 1986). In return, investors demand higher compensation when trading with the IPO company. These risks can be mitigated when a more prestigious underwriter issues the IPO, as the external investors have more trust in them.

Overall, underwriters have incentives to provide certification, pricing, marketing, and monitoring services of quality. These services improve the short- and long-run performance of IPO companies. Therefore, IPOs managed by alike underwriter's lure investors and demand. Consequently, IPOs who are brought to the market by prestigious underwriters are more likely to succeed, and therefore, will ensure a continued stream of IPO deals. In addition, underwriters will earn significant underwriting fees, receive reputational capital, leading to an expansion of their business activities and create a stable clientele for other sectors they are active in, for instance, M&A (Chemmanur and Fulghieri, 1994).

2.1 Initial underpricing of IPO companies

A well-documented phenomenon in the empirical literature is the initial underpricing effect of IPO companies. The initial underpricing effect occurs when the first trading day closing price is higher than the offer price (Beatty and Ritter, 1986). IPO companies and their underwriters set the offer price

lower, as investors need to be compensated for the risks they take when investing in an IPO. This results in a massive amount of money left on the table. Many studies find that the initial public offerings are underpriced.

Ritter (1984) examined 5000 companies that went public from 1960 until 1982 in America. He found that the magnitude of the underpricing is significantly higher for IPOs than for companies that are already public. The average initial return of his sample is positive, with 18.8%. The underpricing effect was calculated using the methodology of Rock (1982). This methodology is based on the belief that underpricing occurs because of information asymmetry between two groups of investors. Firstly, informed investors know more about the prospects of the IPO and have more information. Secondly, the uninformed group that knows less. This paper shows that informed investors tend to invest when an IPO is underpriced and uninformed investors tend to spend in overpriced IPOs. For this reason, the uninformed investors need to be compensated with a lower offer price. I agree that this information asymmetry can cause high levels of initial underpricing and that it can be mitigated by more prestigious underwriter and their experience.

Likewise, the study of Beatty and Ritter (1986) examines 1,018 US IPOs from 1977-1982. They show a 14.1 percent average first trading day return for US IPO companies. In their study, they highlight the role of the underwriter in this underpricing effect. Underwriters risk their reputational capital when they cheat with the offer price. In both studies, Ritter (1984) and Beatty and Ritter (1986) find a relation between the underpricing effect and the ex-ante uncertainty. This relation is discussed in the next section.

Nonetheless, Johnston and Roten (2015) state that the negative relation between underwriter prestige and underpricing effect changed to a positive relationship after 1993. This change was because IPO companies began paying for analyst coverage through increasing initial returns, and the focus was on side payments instead of the price accuracy of underwriters. In addition, Cliff and Dennis (2004) show a positive relation between underwriter prestige and underpricing effect in 1993 until 2000. Still, I do not agree with these studies as underpricing is costly to an IPO. Therefore, the IPO company will select a more prestigious underwriter which is associated with a lower initial underpricing effect due to their experience in assessing the IPO's riskiness.

Furthermore, Schuster (2003) examines 973 IPOs, that went public on the six largest European markets during 1988-1998. These markets are France, Italy, Germany, The Netherlands, Spain, and Sweden. They show a significant underpricing, which is time-varying with a mean initial return of 16.5 percent.

The massive difference between the mean and median is that large amounts of money are left on the table due to the effect of massive privatizations. These results are in line with Ritter (1991).

Moreover, Wasserfallen and Wittleder (1994) examine a sample of only 92 IPOs in West-Germany during 1961-1987. They extend the sample of Uhlir (1989) with ten additional IPOs. The mean initial underpricing effect is positive, with 17.6 percent. Besides, they find only one significant relationship, which is positive between the initial underpricing and a proxy for ex-ante uncertainty. Even so, this relation is in line with a great deal of the previous research.

Furthermore, Ljungqvist (1997) uses a larger sample of 189 German IPOs from 1970 until 1993 to reassess the underpricing effect of Wasserfallen and Wittleder (1994) and Uhlir (1989). However, they use a different proxy for uncertainty to avoid endogeneity problems. In their study, they show a positive average initial return equal to 10.6 percent. They likewise show that the underpricing effect is positively influenced by the economic climate, insider retention rates, and offer size.

Nonetheless, most of the models and patterns examined in the previous studies explaining the underpricing effect, are focused on the American market therefore, less attention goes to the European market. Additionally, the reviews on the German IPO performance are before the year 2000. Meaning, I want to examine the underpricing effect of German IPOs during the last two decades. Furthermore, I will use these studies and their methods to examine the relation between the initial underpricing and underwriter prestige.

2.1.1 Underwriter Prestige and ex-ante Uncertainty

The prestige of the underwriter and their role in mitigating the underpricing effect on IPOs is interdepended with the level of uncertainty during each IPO. Rock (1986) was the first to present the concept of information asymmetry created in an IPO. In this concept, Rock states that IPOs generate an amount of information asymmetry between informed and uninformed investors. This information asymmetry causes the offer price to decrease to lure investors and compensate them for their risk. Plus, Carter and Manaster (1990) show that more prestigious underwriters manage IPO companies that have lower initial returns and lower risk levels. According to them, investors prefer to use their capital to gain information for IPO companies associated with higher uncertainty levels. In this situation, uninformed investors are compensated for trading against informed investors. As a result, the initial underpricing effect is positively correlated with the IPO companies' uncertainty.

Furthermore, Carter and Manaster (1990) suggest that established companies prefer to signal their quality to the investors and, therefore, select more prestigious underwriters. These more prestigious underwriters can assess the uncertainty of the IPO companies. Additionally, prestigious underwriters want to manage IPOs with lower volatility in uncertainty to protect their reputational capital (Chemmanur and Fulghieri, 1994). The trustworthiness of the underwriter is an essential component in the valuation of IPOs.

According to this certification effect of Chemmanur and Fulghieri (1994), IPO companies pick underwriters based on their pricing accuracy. Hence, underwriters can lose prestige and future deals when they underprice. Chemmanur and Fulghieri (1994) show that more prestigious underwriters have reputational capital at risk and, therefore, want to price IPOs accurately. Moreover, company resources and track-record experience help them when it comes to pricing correctly. Consequently, more prestigious underwriters have a lower underpricing effect than IPOs managed by less prestigious underwriters, as they certify that the offer price is more accurate.

Besides this, Megginson and Weiss (1991) show a negative relation between the underpricing effect and underwriter prestige. In addition, Carter et al. (1998) present a negative relationship between the initial underpricing effect and the underwriter prestige when controlling for uncertainty.

Furthermore, Johnson and Miller (1988) show that underwriter prestige does not influence the initial underpricing effect. They show that company uncertainty is the primary variable that positively impact the initial underpricing. They find proof that companies with high uncertainty receive higher initial returns and that more prestigious underwriters prefer to manage IPOs with lower uncertainty. However, Wasserfallen and Wittleder (1994) find no significant difference between the uncertainty of IPO companies managed by prestigious companies compared to those with a less prestigious underwriter. They show that IPO companies of more substantial size select more prestigious underwriters and those IPOs have less underpricing.

In this thesis, I expect that more prestigious underwriters mitigate the ex-ante uncertainty of an IPO as they have more experience in assessing the value and risks of an IPO company. I will use the methods of Ritter (1984) to calculate ex-ante uncertainty. In his paper, he states that a volatile after-market performance can indicate a higher IPO ex-ante uncertainty. He uses the standard deviation of the IPO after-market from the period [t+1, t+26] as a proxy for the ex-ante uncertainty.

2.1.2 IPO Company Size

More prestigious underwriters deal with more low-risk firms. This lower risk will result in lower initial performance and a smaller underpricing effect. Similarly, Carter and Manaster (1990) and Ritter (1984) find that larger firms are associated with lower risk levels. Therefore, more prestigious underwriters tend to deal with more substantial firms (Chemmanur and Fulghieri, 1994; Carter and Manaster, 1990). Subsequently, Megginson and Weiss (1991) show that the level of information asymmetry is lower for larger firms.

2.1.3 Market Return

Some companies choose to issue in specific periods when the stock market is performing well and when market conditions are right. Issuing in such periods can lead to higher initial underpricing as stocks can be overvalued. Moreover, Ljungqvist (1997) shows that market returns for German IPOs are positively correlated to initial returns. In addition, Schiller (1990) states that investors are more willing to invest in IPOs when the market is growing. Furthermore, Aggarwal and Rivoli (1990) find significant results on this matter. Investors have high expectations of IPOs and will invest more in those IPOs and, therefore, the initial return will also increase.

2.1.4 Industry Effect

The impact of different industries on the underpricing effect is a topic that has not been examined often in the past. The influence of industries on the underpricing effect can differ between countries and markets. Some expect that companies are better in the valuation of their company value in the financial sector and, therefore, the initial return is lower (Alli, Yau, and Yung, 2006). However, the most significant industry effect is the technology industry (Hirano, 2011). Technological companies are more underpriced than other industry companies as they are associated with more risks, such as younger of age and challenging to evaluate (Bessler and Bittelmeyer, 2008). Additionally, Bomans (2009) find that European tech-IPOs suffer higher levels of underpricing. In this thesis, I want to examine the impact of several industries on the underpricing effect of German IPOs, but I expect that technology will have the most impact.

2.2 Long-run performance of IPO companies

The company's long-run performance is the change in the value of this company three years after they went public. Another well-documented phenomenon is the long-run underperformance of IPO companies. Ritter (1991) was one of the first to show that IPOs underperform in the long-run. In his paper, he compared a sample of American IPOs to a sample of comparable companies matched by

industry and size. He examined 1.526 IPOs with a mean three-year buy-and-hold return (BHAR) of 34.5 percent and a cumulative abnormal return (CAR) of 29.1 percent. However, the comparable companies performed much better with a mean BHAR of 61.9 percent. He finds that investors are overoptimistic about the company's expectations compared to their real past performance.

Furthermore, Carter et al. (1998) examine the impact of underwriter prestige on the long-run performance of IPOs. The BHAR is adjusted for the return on the CRSP NYSE/AMEX/Nasdaq value-weighted index. They present an average BHAR of -19.92 percent, which indicates a long-run underperformance of IPOs. To examine this research, they used the Carter-Manaster measure, that ranks underwriters into three groups based on their prestige. They use underwriters' relative placements in-stock, offering tombstone announcements to divide them among these three groups. As well as, they show that more prestigious underwriters underperform less severe.

Subsequently, Ritter and Welch (2002) examines 6.249 IPOs from 1980 till 2001 for their long-run performance. The BHAR for the sample of IPOs without adjusting for the market is 22.6 percent. After adjusting for the compounded daily return on the CRSP value-weighted index of Amex, Nasdaq, and NYSE companies, the average BHAR is -23.4 percent, this is in line with the previous literature. Furthermore, Goergen, Khurshed, and Mudambi (2007) examine 252 UK IPOs, which show a negative long-run performance of -20.8 percent. They use the same methodology as Carter et al. (1998) and use a market index of small companies, but when they use a market index representing the whole market, the mean BHAR decreases to -18.6 percent.

Most of the literature about the long-run performance of German IPOs focuses on measuring long-run performance and not the influence of their factors. These studies document a long-run underperformance of German IPOs. Nonetheless, the negative long-run performance of IPOs is not as evident as observed in the American stock market, even when changing the market index. Ljungqvist (1997) was one of the first examining the long-run performance of German IPOs alone. He investigated a sample of 189 IPOs from 1970 to 1993. Using the DAFOX market index to adjust the returns, the IPOs underperformed on average with -12.1 percent. Furthermore, Sapusek (2000) examines the effect of the benchmark choice for adjusting the stock returns for the period 1983-1993. The BHARs of German IPOs are neutral or negative, depending on the benchmark choice. Also, he finds the same significant underperformance as Ljungqvist (1997). However, Stehle et al. (2000) show different results than the previous articles. They find that the long-run performance of German IPOs is better than that of American IPOs. The mean three-year BHAR for their sample, between 1960 and 1992, was benchmarked to the value-weighted index of the top listed companies of the Frankfurt stock exchange,

and the value-weighted index on size is 1.5 and -6.6 percent. Lastly, Bessler and Thies (2006) examine a sample of German IPOs between 1977 and 1995 and select the DAX index as a proxy for the market index. They show that a mean BHAR of -12.7 percent, which is in line with Ljungqvist (1997). Besides this, they present a more severe underperformance of IPOs around 1990.

In this thesis, I will use the same method as Carter et al. (1998) to examine the long-run performance of my IPO sample. Furthermore, I will use the method of Bessler and Thies (2006) when selecting the DAX as a benchmark for the market index as a market index eliminates subjective interference.

2.2.1 Underwriter Prestige

Carter et al. (1998) examine the impact of the underwriter prestige on the long-run performance of US IPOs. They are the first to show a positive relationship between the underwriter prestige and the long-run performance. In this paper, they select three proxies to measure the underwriter prestige that is developed and used in previous studies, which examined the relation between underwriter prestige and initial underpricing effect (Johnson and Miller, 1988; Megginson and Weiss, 1991; Carter and Manaster, 1990). Overall, they show that IPO companies underwritten by more prestigious underwriters suffer less severe underperformance compared to the market. This conclusion is in line with Chemmanur and Fulghieri (1994), who suggest that prestigious underwriters select individual IPO companies, which perform better in the long-run, to protect their reputational capital and maintain their status as having the ability to separate quality companies from 'lemons.' Furthermore, both studies show that more prestigious underwriters want to associate themselves with quality IPO companies, as they can maintain the investors' trust in providing accurate certification of IPO company value and build a clientele for other business sectors.

Additionally, Dong, Michel, and Pandes (2011) show more proof of the positive relationship between the underwriter prestige and the long-run performance of IPOs. They examine the influence of the certification, marketing, and information services that underwriters provide during an IPO on the IPO company's long-run performance. The model in this paper is different from the previous studies as it is similar to the Fama French three-factor model, including an extra investment factor. The results show that the marketing and certification services have a significant positive influence on the long-run performance and, therefore, the positive relation between the underwriter prestige and the long-run performance.

Furthermore, Wang, Liu, and Wu (2003) examine the relationship between the underwriter prestige and the long-run performance of Chinese IPOs. They find a positive long-run performance for the

Chinese stocks, which is not in line with Ritter (1991). Besides, they find a positive correlation with the underwriter prestige, indicating that more prestigious underwriters have a positive relationship with the long-run performance of Chinese IPOs.

2.2.2 Ex-ante Uncertainty

Information about IPOs before they go public is limited, as the companies are still private. Still, some IPO companies are associated with higher levels of risks and uncertainty. Empirical literature shows that IPOs with higher risks and uncertainty tend to have more severe underperformance in the long run. In these studies, they use ex-post proxies to measure the ex-ante uncertainty of an IPO company.

In the paper of Carter et al. (1998), they use the standard deviations of the IPO company stock returns to predict the company's prior-IPO risk over 255 trading days. They validate the negative impact of the ex-ante uncertainty on the three-year BHARs of each IPO. Also, Johnson and Miller (1988) show a negative relation between the three-year BHAR and the ex-ante uncertainty. Investors who invest in IPOs with more uncertainty, have higher expectations about the returns, which are challenging to accomplish and, therefore, underperform the expectations in the long-run.

Furthermore, Dong et al. (2011) present another proxy for the ex-ante uncertainty of an IPO company: residual volatility. This proxy is measured as the standard deviation of the residuals from a market model. They use an entire trading month after the IPO (approximately 25 days) and the CRPS market index as a proxy for the market return. As a result, they find that in most of their regression analyses, the ex-ante uncertainty does not affect the long-run performance of IPOs. However, they show one regression analysis with a positive significant coefficient for ex-ante uncertainty, which indicates weak evidence that investors are compensated for investing in more risky IPOs with higher long-run performance.

2.2.3 IPO Company Size

In most literature, larger companies are associated with lower levels of risk. This lower risk should mitigate the long-run underperformance of IPO companies. Ritter (1991) shows that smaller IPO companies tend to underperform more severe as there are more risks. Additionally, Carter et al. (1998) find that larger companies are more familiar to investors and suffer less asymmetry information problems that perform better in the long-run. Furthermore, Goergen et al. (2007) show similar results as Ritter (1991) regarding the impact of company size on the three-year BHAR of UK IPOs.

However, Bessler and Thies (2006) present an opposite relation between company size and the long-run performance of German IPOs. This negative relation is not in line with previous studies. Commonly, a larger IPO company is associated with lower levels of risks and less severe underperformance.

2.2.4 Market Return

Companies tend to issue equity when they are in an overvalued market as they receive more cash. Ritter (1991) shows that in these periods of overvaluation, companies suffer more severe underperformance. Investors are overoptimistic about the value of IPO companies. When investors become more informed, they adjust their expectations, leading to underperformance in the long-run. Furthermore, Loughran and Ritter (1995) connect the windows of opportunity theory, which executives exploit when issuing equity to the long-run underperformance of IPO companies. In this situation, the initial returns rise, making it difficult for IPO companies to match the same value with their long-run returns and, therefore, the long-run performance is lower. So, there is an aftermarket correction for the high values.

2.2.5 Industry Effect

The long-run underperformance of IPOs is a well-documented issue that is examined in the past years. Ritter (1991) shows a relative underperformance of IPO companies compared to companies matched by size and industry. Besides, Ritter discusses the long-run performance of IPOs across different industries. In his sample period of 1975 until 1984, IPOs of financial companies, such as banks, show superior long-run performance compared to gas and oil IPO companies. Also, high-tech companies perform worse in the long-run compared to the matched companies. In this thesis, I want to examine the impact of the industry on the long-run IPO performance in Germany.

2.3 Hypotheses Development

In this thesis, I examine the impact of the level of underwriter prestige on the short- and long-run performance of German IPOs. Therefore, I divide the hypotheses into two main sections. First, the focus will be on the underpricing phenomena around IPOs. Secondly, the long-run performance of IPOs will be the focus.

In the literature review, I will discuss the impact of underwriter prestige on the underpricing of IPOs in the short- and long-run performance. The underpricing effect arises when the offer price is lower than the first trading day closing price, which is mostly a compensation for the uninformed investors to take the risk. When a more prestigious underwriter manages an IPO, the underpricing effect is less severe, as a more prestigious underwriter can make a better assessment of the company value (Titman and Trueman, 1986). In addition, Chemmanur and Fulghieri (1994) state that more prestigious underwriters manage less risky companies as their reputational capital is at stake. Likewise, underpricing is less severe, as more prestigious underwriters underwrite less risky companies (Carter and Manaster, 1990). Carter and Manaster (1990) state: "Underpricing is costly to an IPO company". For this reason, low risk companies want to present this low-risk characteristic to investors and the market. Selecting a high prestigious underwriter is a way to do this. These findings led to the following hypothesis:

H1: IPO companies underwritten by prestigious underwriters experience less initial underpricing.

IPOs with higher ex-ante uncertainty tend to be riskier and have higher initial performance (Beatty and Ritter, 1986). For this reason, underwriters and the IPO firms have to lure new investors into taking risks by lowering the offering price. On the other hand, we have informed investors, which choose to incur information acquisition costs, and uninformed investors, which attempt to free ride. These uninformed investors are faced with a winner's curse problem as they have less information and tend to overestimate. Therefore, faced with this winner's curse problem, an uninformed investor will only purchase stocks if the IPO is underpriced. According to Beatty and Ritter (1986), the degree of underpricing is directly related to ex ante uncertainty as they state the following: "This is because, as the ex-ante uncertainty increases, the winner's curse problem intensifies". For this reason, the uninformed investor demands that the IPO company leave more money on the table by underpricing the IPO. This literature has led to the second hypothesis:

H2: IPO companies with a higher level of ex-ante uncertainty experience higher levels of initial underpricing.

When a firm goes public, there are certain risks involved regarding the ex-ante uncertainty, as investors do not have all the information. This information asymmetry is mitigated when IPO firms hire a more prestigious (Chemmanur and Fulghieri, 1994). In addition, Carter and Manaster (1990) suggest that more established companies with lower risks tend to select more prestigious underwriters. Overall, prestigious underwriters have more experience in assessing the value and risks of an IPO company. Therefore, based on the previous literature, the following hypothesis is constructed:

H3: A more prestigious underwriter mitigates the ex-ante uncertainty of an IPO.

Carter et al. (1998) shows that low-risk companies associate themselves with more prestigious underwriters and, therefore, those IPO companies perform better in the long-run. Besides, Chemmanur and Fulghieri (1994) find that more prestigious underwriters select IPO companies that perform better in the long run. When selecting IPOs to underwrite, the lemon problem of Akerlof (1970) arises, as the IPO companies know more about the value and risks and could overestimate their performance. However, Chemmanur and Fulghieri (1994) believe that prestigious underwriters have more experience and abilities to value company performance and, therefore, can associate themselves with IPOs who have better long-run performance. They state: "…it reduces the probability of them marketing lemons and damaging their reputational capital stake.". Hence, these findings led to the following hypothesis:

H4: IPO companies underwritten by more prestigious underwriters experience a better long-run performance.

The higher the ex-ante uncertainty of an IPO firm, the higher the risks regarding the IPO. These higher risks mean that new investors expect a higher return on their investment. However, such high expectations can be challenging to accomplish and can create a lower long-run performance (Johnson and Miller, 1988). So, when more information becomes available, the prices and investor's expectations will adjust downwards in the long-run and, therefore, the long-run performance will underperform. Hence, the fifth hypothesis is constructed:

H5: IPO companies with higher levels of ex-ante uncertainty experience long-run underperformance.

In this thesis, I will control the initial underpricing and the long-run performance for size, ex-ante uncertainty, market return and industry effect.

3. Data

The sample consists of only German IPOs from 1984 until 2015. I select this specific period for my empirical analysis since it allows me to examine the factors of the short- and long-run performance of German IPOs. Additionally, this period adds new information about the impact of underwriter prestige on the short- and long-run performance of German IPOs, as it has never been examined before. Data about the name of the issuer, offering and first-trade dates, offer and first trade closing price, offer size and shares outstanding are collected and combined from four databases: Securities Data Corporation (SDC) New Issues Database incorporated in Thomson One, Bloomberg Database, the website of the Deutsche Börse AG and Käserer Database. Additionally, data about the IPO lead underwriter and company founding dates are collected from ZEPHYR Database. Finally, all daily stock and market prices are obtained from Compustat Global via WRDS. All data is combined based on International Securities Identification Number (ISIN) and Bureau-van-Dijk identification (BvD-id) codes.

This thesis's primary purpose is to examine the impact of underwriter prestige on the short- and long-run performance of German IPOs. For this reason, I collected a dataset with a total of 926 German IPOs. Some companies were listed on more than one stock exchange and had to be removed. After excluding all these duplicate companies with the same ISIN code, issuer name, and offering date, the dataset is reduced to 879 IPOs. Subsequently, IPOs with missing data about issuer name, ISIN code, underwriter name, offer size or offer price were excluded from the dataset. The resulting sample after this cleaning step is 479. Additionally, I have eliminated all the observations with missing closing prices or standard deviations not available in Compustat Global. The final dataset contains 442 German IPOs, which I will use to conduct my regressions (See Table 1).

To create the underwriter prestige variable, I select the lead underwriter from ZEPHYR Database for all IPOs in my final sample. When an IPO had multiple underwriters, I choose the lead underwriter. Subsequently, I manually searched whether underwriters were merged and adjusted for this in the sample. The final sample of underwriters contains 114 underwriters divided over 442 IPOs. The relative market share is based on two different measures; the total sum of gross proceeds of IPOs assisted by the underwriter divided by the entire gross proceeds of the dataset and the number of IPOs supported by the underwriter divided by all the IPOs in the dataset.

Table 1 – Sample selection process

Total number of companies in raw sample	926
Minus: IPO companies listed on multiple stock exchanges (duplicates)	-47
Subtotal (1)	879
Minus: IPOs with missing data (issuer name, ISIN, underwriter, offer size or offer price)	-400
Subtotal (2)	479
Minus: IPOs with missing standard deviations	-37
Total	442

Table 1 shows the selection criteria for the sample of 926 German IPOs. The data is obtained from ThomsonOne, Bloomberg, Kaserer, Zephyr and Orbis with an issue date between 1984 until 2015.

The final dataset contains 442 German IPOs from 1984 until 2015. In panel A of Table 2, I show the distribution of all the IPOs by year of issuing, in terms of number of IPOs, the initial returns and the sum of gross proceeds. The gross proceeds are measured with the offer price times the shares offered. The total number of IPOs in the dataset ranges from a low of 1 in 2013 and 2015 to a high of 82 in 1999. The distribution of IPOs by gross proceeds is shown in panel B of Table 2. Small size IPOs with gross proceeds lower than 20 million represent 25.6 percent (113 IPOs) of the dataset and 14.7 percent of the total gross proceeds. The large size IPOs with gross proceeds higher than 200 million represent 14.7 percent (65 IPOs) of the dataset and 12 percent of the total gross proceeds.

Table 2 - Initial Returns and Gross Proceeds by IPO Year (A) and proceed size (B)

	N	Initial Returns	Gross Proceeds
Panel A:			
1984	3	-13.54	102,633,333
1985	3	101.79	35,813,333
1986	7	12.11	154,700,000
1987	7	26.10	55,108,571
1988	6	10.55	55,951,667
1989	10	25.71	102,731,000
1990	15	-22.95	161,122,667
1991	16	-16.89	163,958,125
1992	6	-28.69	66,141,667
1993	6	-4.31	117,533,333
1994	5	195.78	47,168,000
1995	9	8.53	678,922,222
1996	7	25.35	1.521,762,847
1997	16	41.01	253,940,776
1998	41	14.18	92,882,288
1999	82	43.93	121,386,179
2000	61	45.97	290,877,693
2001	13	-29.75	130,917,703
2002	4	-28.86	51,763,736
2004	4	-6.34	107,083,670
2005	18	10.47	128,984,627
2006	49	7.00	97,917,767
2007	33	5.00	243,475,931
2008	2	14.24	7,987,500
2010	9	3.13	253,296,952
2011	6	40.73	198,132,732
2012	2	4.77	418,674,990
2013	1	-1.25	39,000,000
2015	1	3.574.42	6,340,020
total	442	29.34	189,846,084
Panel B:			
GP_<_20m_EUR	113	45.00	10,883,124
20m_EUR_<_GP_<_50m_EUR	114	29.04	33,321,015
50m_EUR_<_GP_<_200m_EUR	147	28.26	95,388,113
200m_EUR_<_GP	65	3.66	1.008,620,028
total	442	29.34	189,846,084

Table 2 shows the sample of 442 IPOs listed in Germany over the period 1984 until 2015. Panel A presents the distribution of IPOs by listing year. Panel B presents the distribution of IPOs by gross proceeds. Both panels are in terms of number of IPOs, mean market adjusted initial returns and mean gross proceeds. The market adjusted initial returns are presented in percentages and the gross proceeds in €.

4. Methodology

4.1 Dependent Variables

4.1.1 Initial Return

The initial return of an IPO is used to measure short-run performance. We determine the initial return by using the first trading day return when the firm goes public (Ljungqvist, 1997; Carter et al., 1998; Goergen et al., 2007). To calculate the initial return, I look at the percentage difference between the first trading day closing price and the offering price. As shown by Beatty and Ritter (1986), the average initial return of an IPO is 14.1 percent (positive), which indicates an underpricing effect. The initial return is used to examine whether it can be affected by the underwriter prestige. We use the formula of Johnson and Miller (1988) to calculate the initial return.

$$R_{i,t} = \frac{(B_{i,t} - OP_i)}{OP_i}$$

Where $\mathrm{R_{i,t}}$ is the initial return for $\mathrm{IPO_i}$ on day t, $\mathrm{OP_i}$ is the offering price of $\mathrm{IPO_i}$ and $\mathrm{B_{i,t}}$ is the closing bid price of $\mathrm{IPO_i}$ on the first trading day. Subsequently, I will adjust the first trading day returns with the market returns on the day of trading due to the precision and consistency of the results (Goergen et al., 2007). The correct market index is used to benchmark each company's performance depending on its listed stock exchange. So, the following formula is used to calculate the market return for the IPOs:

$$R_{m,t} = \frac{\left(O_{m,t} - C_{m,t}\right)}{C_{m,t}}$$

Where $\mathrm{R_{m,t}}$is the initial return for market index m on day t, $\mathrm{O_{m,t}}$ is the opening price for market index m on day t and $\mathrm{C_{m,t}}$ is the closing price for market index m on day t. Now, we will adjust the initial return with the market index according to the following formula:

$$IR_{i,t} = R_{i,t} - R_{m,t}$$

Where $\mathrm{IR_{i,t}}$ is the initial return adjusted for the market return.

4.1.2 Long-run Performance Evaluation and Choice

One of the hardest issues associated with the evaluation of the long-run performance of IPOs are the various calculation methods and benchmarks used in the existing literature. Existing literature has

documented a variation of calculation methods for the long-run performance of IPOs. Still, two of them are the most common: The Cumulative Abnormal Returns (CAR) and the Buy-and-Hold Abnormal Returns (BHAR). Lyon et al. (1999) state that the BHAR method is more appropriate than the CAR method for calculating the long-run performance of IPOs. Furthermore, they suggest that the BHAR is more essential due to the precisely measurement of the real BHAR experience of the investors.

Moreover, the various types of benchmarks can also complicate an objective evaluation of the results. Loughran and Ritter (1995) state that the calculation of the long-run IPO performance can be very sensitive to the benchmark choice. In their study, they show three adjustment methods that can be used to measure the long-run performance of IPOs. In the first method, they compare an IPO return against the return of a non-IPO company with similar characteristics, such as industry, market value ratio's and market capitalization. This method is widely used in IPO studies of developed capital markets. The second method is comparing the sample to a self-built reference portfolio containing non-IPO companies with similar characteristics. Similarly, this method needs a large matching company universe and, therefore, is appropriate for large capital markets. The last method is the comparison of IPO company returns against a benchmark portfolio. This is for stock markets with a narrow range of comparable companies. A drawback can be that the measured IPO effects can be included in the benchmark performance. Still, there are two advantages which have led to my selection of this method. First is the lack of any subjective interference on the composition of the benchmark portfolio. Secondly, market indexes are better benchmarks for the performance calculation of new issued companies, as they include smaller companies which are more similar to IPO companies (Sapusek, 2000).

In this thesis, the long-run performance of an IPO is examined by computing the buy-and-hold abnormal returns (BHAR) and the cumulative abnormal returns (CAR) compared to the market index returns of the DAX. I use the investment strategy of buying the IPO share at the first trading day closing price and selling it after a three-year holding period. I assume that each year has an average number of 242 trading days. Therefore, I calculate the buy-and-hold return for 726 days following the first day of listing. Carter et al. (1988) find that IPOs underwritten by more prestigious underwriters perform better in the long-run. In this thesis, we use the methodology to calculate the long-run performance in line with Carter et al. (1998), and, Loughran and Ritter (1994):

$$BHAR_{i,t} = \left[\prod_{t=1}^{T}\left(1 + R_{i,t}\right) - 1\right] - \left[\prod_{t=1}^{T}\left(1 + R_{m,t}\right) - 1\right]$$

Where $\mathrm{R_{i,t}}$ is the initial return for $\mathrm{IPO_i}$ on day t and $R_{m,t}$ is the daily return on the market index.

The mean abnormal returns $\overline{BHAR_T}$ on a sample of N shares for a holding period of *T* days is computed as:

$$\overline{BHAR_T} = \frac{1}{N}\sum_{t=1}^{N} BHAR_{t,T}$$

Bootstrapped skewness adjusted t-tests are used to examine if the BHAR is significant different from zero (Lyon et al., 1999):

$$t(\mathrm{BHAR}_t) = \sqrt{N}\left(S + \frac{1}{3}\hat{y}S^2 + \frac{1}{6N}\hat{y}\right),$$

where

$S = \frac{\overline{BHAR_T}}{\sigma(BHAR_t)}$, and $\hat{y} = \frac{\sum_{i=1}^{N}(BHAR_{i,t} - \overline{BHAR_T})^3}{N\sigma(BHAR_t)^3}$

where *S* is the skewness, and $\hat{y}$ is the estimate of the skewness coefficient. The abnormal return $AR_{i,t}$ for a company *i* on event day *t* is calculated as:

$$AR_{i,t} = R_{i,t} - R_{m,t}$$

The mean market adjusted return AR_T on a sample of N shares on event day t is defined as:

$$AR_T = \frac{1}{N}\sum_{t=1}^{N} AR_{i,t}$$

Hence, the cumulative market adjusted returns CAR_T from event day 1 to event day T is the sum of AR_T:

$$CAR_T = \sum_{t=1}^{T} AR_T$$

The methodology of Ritter (1991) is used to determine the t-tests of the CAR_T as follows:

$$t(CAR_T) = CAR_T * \sqrt{\frac{N}{csd_t}},$$

Where

$$csd_t = [t * var + 2 * (t-1) * cov]^{0.5}$$

Where 'var' is the mean cross sectional variance over 726 days and 'cov' is the first order autocovariance of the AR_T series.

Table 3 - BHAR and CAR of IPOs by Event Days

Event Days	BHAR*t*	*t* stat	CAR*t*	*t* stat
61	6.95	2.76***	3.57	2.14***
121	5.23	1.24	-0.14	-0.06
182	-2.20	-0.43	-7.47	-2.75***
242 (one-year window)	-12.10	-1.93*	-14.83	-4.75***
303	-22.32	-2.24***	-23.81	-6.72***
363	-27.02	-0.82	-27.62	-7.09***
424	-35.67	-0.97	-33.42	-6.42***
484 (two-year window)	-37.90	-1.84*	-35.54	-5.33***
545	-41.33	-4.22***	-37.89	-5.11***
605	-44.72	-4.89***	-38.47	-4.79***
666	-45.19	-5.71***	-32.72	-3.72***
726 (three-year window)	-43.49	-3.30***	-20.68	-1.98***

Table 3 shows the market adjusted buy-and-hold abnormal returns (BHARs) and cumulative abnormal returns (CARs) of 442 German IPOs from 1984 until 2015. Significance at the 10, 5 and 1 percent levels are indicated with *, ** and ***.

In Table 3, I examine the long run performance of IPOs by calculating the buy-and-hold abnormal returns (BHARs) and cumulative abnormal returns (CARs) and test their significant difference in several periods until a three-year window. After, I continued with the BHAR as a proxy for the long-run performance. Table 3 presents the market adjusted BHARs and CARs, that show a consistently poor performance from three months until three years after the IPO. The mean three year BHAR is -43.5 (t-stat = -3.30) which is in the same trend as Uhlir (1989) with -27.2 (t-stat = -3.5). Additionally, Carter et al. (1998) show a mean BHAR of -19.9 percent. However, Wittleder and Wasserfallen (1994) only show a mean BHAR of -1.8 (t-stat = -0.3).

4.1.3 Benchmark

The sample of my thesis consist of only German IPOs. Therefore, I select the DAX index as a proxy for the market return. I have chosen this market as it is comparable to the S&P 500 in the United States. This market index represents 80 percent of the market capitalization of listed stock corporations in Germany.

4.2 Control Variables

In this section, I present the empirical model which I will use to determine the effect of the independent variables on the previously discussed initial return and the long-run performance of German IPOs.

4.2.1 Underwriter Prestige

Underwriter prestige can affect the performance of an IPO. Literature shows that more prestigious underwriters offer IPOs with lower uncertainty and less underpricing (Beatty and Ritter, 1986). Nonetheless, Johnson and Roten (2015) find some contradicting evidence that indicates that the relation between underwriter prestige and the underpricing effect is positive after 1993. Additionally, IPOs issued by more prestigious underwriters have less severe long-run underperformance (Ritter, 1991; Dong et al., 2011). In these studies, they use several different measures for underwriter prestige. The three most common proxies for the underwriter prestige are from Carter and Manaster (1990), Johnson and Miller (1988), and Megginson and Weiss (1991). Megginson and Weiss (1991) take the market share of all IPO underwriters as a measure of prestige, based on the gross proceeds. Johnson and Miller (1988) rank underwriters in four categories. Prestigious underwriters receive rank three; medium-prestigious underwriters receive rank two, low-prestigious underwriters receive one, and those with a bad reputation receive a zero. Carter and Manaster (1990) use tombstones announcements to measure underwriter prestige. This measure is a ten-tier prestige measure with rankings from zero to nine, where zero is the lowest and nine is the highest. Since the Carter and Manaster (1990) method is a bit outdated for our sample period, I will use two different underwriter prestige measures based on Megginson and Weiss (1991) methods. The first prestige measure, called 'Prestige_GrossProceeds', is based on the assumption that the higher the gross proceeds raised by an underwriter, the higher the underwriter prestige. The underwriter prestige is measured as the ratio of the total gross proceeds raised by the underwriter to the entire gross proceeds raised in my sample—the mean Prestige_GrossProceeds rank for 442 IPOs is 2.2 percent with a median of 0.7 percent. The second prestige measure, called 'Prestige_IPOs', assumes that the more IPOs an underwriter has managed, the higher the underwriter prestige. The underwriter prestige is measured as the total of all IPOs managed by the underwriter in my sample. The mean Prestige_IPOs rank for 442 IPOs is 10.2 percent, with a median of 6.0.

To test how the levels of underwriter prestige impact the short- and long-run performance, we will divide the underwriters into three different groups accordingly to the method of Johnson and Miller (1988):

Prestige_GrossProceeds:

- *Rank 3 for underwriters of high prestige (Prestige_GrossProceeds ≥ 3%)*
- *Rank 2 for underwriters of medium prestige (1% ≤ Prestige_GrossProceeds < 3%)*
- *Rank 1 for underwriters of low prestige High (Prestige_GrossProceeds ≥ 3%)*

Prestige_IPOs:

- *Rank 3 for underwriters of high prestige (Prestige_IPOs ≥ 16)*
- *Rank 2 for underwriters of medium prestige (9 ≤ Prestige_IPOs < 16)*
- *Rank 1 for underwriters of low prestige (Prestige_IPOs ≤ 9)*

4.2.2 Company Size

Carter et al. (1998) find that more established companies tend to issue larger IPOs. They show that the risks are more likely to be diminished and, therefore, the initial returns should be smaller. As well as, they find that more prestigious underwriters underwrite those IPOs. Additionally, Goergen et al. (2007) find that larger firms have a higher long-run performance.

Furthermore, Beatty and Ritter (1986) show that small-size companies are subject to more uncertainty since they publish less information to investors and are less established and risky. In this thesis, I control for any systematic influence due to firm size and measure size as the log of total market capitalization (LnSIZE).

4.2.3 Ex-ante Uncertainty

When a firm decides to go public, there is much uncertainty around the firm value. Investors do not know whether the offer price is the right price. All this uncertainty increases the underpricing effect, as underwriters and the IPO firm want to lure investors (Beatty and Ritter, 1986). Literature shows various methods to measure this IPO uncertainty. In this thesis, I will measure the IPO ex-ante uncertainty as to the standard deviation of daily returns of each IPO over 25 days, starting from the first trading day (+1) through the first trading day (+26) according to Ritter (1984). They find that more volatile performance during this aftermarket period implies higher IPO ex-ante uncertainty. The IPO ex-ante uncertainty is calculated according to the following formula:

$$\boldsymbol{STD = \sigma_j - (\beta_{,j} * \ \sigma_m)}$$

Where

STD *= Ex-ante uncertainty proxy of an IPO firm*

σ_j *= Standard deviation of an* IPO_j *after-market performance during period [+1, +26]*

$\beta_{,j}$ *= Beta for* IPO_j

σ_m *= Standard deviation of the market index performance during period [+1, +26]*

4.2.4 Market Return

The market return can influence the performance of an IPO. Loughran and Ritter (1994) show that when the market return before the offer date is high, the underpricing is greater. Subsequently, this high underpricing effect tends to lead to long-run underperformance as the returns are too high to maintain. Additionally, Derrien and Womack (2003) find that market returns significantly affect the initial returns' volume and variability. The market return is determined as the average daily return on the corresponding DAX Index for the three months before offering the IPO.

4.2.5 Industry

As companies in diverse industries can have different effects on the performance of IPOs, I have used Standard Industrial Classification (SIC) codes. I control for industry effect in the regression analyses, but I am interested in SIC code number seven (technology) and number six (financial). Ritter (1991) uses a high-tech dummy to measure whether an IPO company in the technology sector has tech services/products for future development. Also, he shows that financial companies perform better in the long-run. Additionally, high-tech companies tend to outperform non-tech companies due to high-quality patents and growth opportunities (Bessler and Bittelmeyer, 2008). Compared to other industries, high-tech companies have more risks and uncertainty, which causes higher initial returns and less severe long-run underperformance.

For the industry class, given in SIC, I divide the data into ten various classes based on the first digit of their Standard Industrial Classification (SIC) code. This method will give us the following ten various classes:

0 = Agriculture, Forestry and Fishing
1 = Mining and Construction
2 = Manufacturing 1
3 = Manufacturing 2
4 = Transportation, Communications, Electric, Gas and Sanitary Service
5 = Wholesale Trade and Retail Trade
6 = Finance, Insurance and Real Estate
7 = Services 1 (Technology)
8 = Services 2 (Medical)
9 = Public Administration

4.3 Regression Analyses

I will conduct cross-sectional Ordinary Least Squares (OLS) regression analyses to examine the explanatory impact of the two underwriter prestige measures. I will regress two dependent variables, the market adjusted initial return (IR) and the Buy-and-Hold Abnormal Return (BHAR) for each IPO, on the two underwriter prestige measures separately. The market corrected initial return is a proxy for the short-run performance of IPOs, and the BHAR is a proxy for the long-run performance of the IPOs. To examine the marginal impact of the underwriter prestige measures, the regression analyses control for firm size (LnSIZE), ex-ante uncertainty (STD), market return (MARKET), and industry effect (INDUSTRY). Therefore, I will conduct four regression analyses in total, which are divided into the following two empirical models:

$$IR = \alpha + ß1 * [Underwriter\ prestige] + ß2 * [Big6\ or\ ß3 * Big6_1 + ß4 * Big6_2 + ß5 * Big6_3 + ß6 * Big6_4 + ß7 * Big6_5 + ß8 * Big6_6] + ß9 * LnSIZE + ß10 * STD + ß11 * MARKET + ß12 * INDUSTRY + \varepsilon$$

$$BHAR = \alpha + ß1 * [Underwriter\ prestige] + ß2 * [Big6\ or\ ß3 * Big6_1 + ß4 * Big6_2 + ß5 * Big6_3 + ß6 * Big6_4 + ß7 * Big6_5 + ß8 * Big6_6] + ß9 * LnSIZE + ß10 * STD + ß11 * MARKET + ß12 * INDUSTRY + \varepsilon$$

5. Results

5.1 Descriptive Statistics

The descriptive statistics (Panel A) and the Pearson correlation coefficients (Panel B) for each of the main variables for 442 German IPOs are presented in Table 4.

Table 4- Descriptive statistics (A) and Pearson correlation coefficients for main variables (B)

Variables	Mean	P50	Max	Min	STD
Panel A:					
IR	0.293	0.015	35.744	-0.996	1.961
BHAR3y	-0.435	-0.451	4.989	-2.075	0.708
SIZE (€million)	189.85	46.00	10.399.91	0.14	690.57
STD	0.030	0.024	0.210	-0.020	0.027
MARKET	0.001	0.001	0.005	-0.007	0.002
Prestige_GrossProceeds	0.022	0.007	0.124	0.000	0.030
Prestige_IPOs	10.24	6.00	35.00	1.00	10.40

Variables	IR	BHAR3y	SIZE	STD	MARKET	Prestige_GrossProceeds	Prestige_IPOs
Panel B:							
IR	1.000						
BHAR3y	-0.141	1.000					
SIZE	-0.019	0.040	1.000				
STD	0.009	-0.019	-0.098	1.000			
MARKET	0.139	-0.134	0.067	0.065	1.000		
Prestige_GrossProceeds	-0.052	0.002	0.241	-0.020	0.090	1.000	
Prestige_IPOs	-0.024	0.002	0.012	-0.046	0.063	0.897	1.000

Panel A of Table 4 presents the descriptive statistics of the market adjusted initial return, three year BHAR and five control variables including the two underwriter prestige measures for 442 German IPOs from 1984 until 2015. Panel B of Table 4 presents the Pearson correlation coefficients of these variables. The market adjusted initial return (IR) is the percentage difference between the offer price and the first trading day closing price, relative to the market return on the DAX Index. The market-adjusted 3-year buy-and-hold return (BHAR3y) is calculated from the listing date +1 through the listing date +726 using the buy-and-hold strategy. SIZE represents the total market capitalization of the IPO company. STD represents the standard deviation of returns for each company and is estimated from a time series of daily raw returns using the listing date +1 through the listing date +26. MARKET represents the average return on the DAX Index for 3 months before offering. Prestige_GrossProceeds is the underwriter prestige ranking variable using the ratio of the gross proceeds raised by each underwriter. Prestige_IPOs is the underwriter prestige ranking variable using the number of IPOs managed by each underwriter. The values of IR, BHAR, STD, MARKET, and Prestige_GrossProceeds are presented in percentages. The value of SIZE is presented in millions of € and the value of Prestige_IPOs is presented in number of IPOs.

Panel A in Table 4 shows that the initial return has a mean of 29.3 percent for 442 IPOs, which means that investors make an average return of 29.3 percent on the first trading day. Higher initial returns say that IPOs are underpriced. This underpricing effect is examined and proven by Ritter (1984),

Ibbotson (1975), and Beatty and Ritter (1986). Ritter (1984) shows a mean initial return of 18.8 percent, which is in line with our sample. Furthermore, Wasserfallen and Wittleder (1994) and Beatty and Ritter (1986) present a mean initial return of 17.6 percent and 14.1 percent. There is a large gap between the minimum and maximum initial returns in the sample, which indicates that the values are not close to the mean. Also, the high level of the standard deviation supports this finding.

The three-year BHAR has a mean of -43.5 percent for 442 German IPOs, which indicates that IPOs underperform in the long-run with 43.5 percent (buying on day one and holding until day 726). Also, Carter et al. (1998) show a mean BHAR of -19.9 percent, which is in line with our results, but less severe underperformance than my sample. Ritter and Welch (2002) and Ritter (1991) state that American IPOs underperform the market with -23 percent and 34.5 percent. Furthermore, Schuster (2003) shows that before 2000, IPOs in most European countries underperform somewhere from -12 to -42 percent in three years. Subsequently, a median of -45.1 percent indicates that more than half of the sample has a negative long-run performance.

Panel B in Table 4 shows some interesting correlations between the main variables. The relationship between the initial return and the long-run performance is negative with -14.1 percent, indicating that a higher underpricing effect leads to lower long-run performance. When the initial returns rise, it becomes hard for companies to level this performance for three years and, therefore, the BHARs underperform. Also, Carter et al. (1998) show a correlation of -3.0 percent between the market adjusted initial returns and the long-run performance.

Furthermore, Table 4 shows that the underwriter prestige and size are positive, with 24.1 percent (Prestige_GrossProceeds) and 1.2 percent (Prestige_IPOs). This relation means that larger companies have a preference for more prestigious underwriters. Also, Carter and Manaster (1990), and Ritter (1984) find that larger companies are associated with lower levels of ex-ante uncertainty. Therefore, more prestigious underwriters tend to deal with more substantial companies (Chemmanur and Fulghieri, 1994; Carter and Manaster, 1990; Logue, 1973). The negative relation between size and ex-ante uncertainty, with -9.8 percent in Table 4 shows that larger companies are associated with lower risk levels.

Additionally, the underwriter prestige measures are highly correlated with each other, with 89.7 percent. Therefore, I conduct two different regression analyses, including one of the underwriter prestige measures, to avoid multicollinearity issues.

Lastly, panel B in Table 4 shows the correlation between the underwriter prestige and ex-ante uncertainty (STD) is negative, with -2.0 percent (Prestige_GrossProceeds) and -4.6 percent (Prestige_IPOs). This relation indicates that more prestigious underwriters mitigate the ex-ante uncertainty of IPOs. Additionally, Chemmanur and Fulghieri (1994) show that information asymmetry, which causes the ex-ante uncertainty, is reduced when an IPO company hires a more prestigious underwriter to get an improved offer price. Furthermore, Carter et al. (1998) show a negative relation between underwriter prestige and ex-ante uncertainty with -13.0 percent, which is in line with my results. Therefore, I can accept the third hypothesis, which states, "*A more prestigious underwriter mitigates ex-ante uncertainty of an IPO.*"

5.2 IPO performance categorized by underwriter prestige measures

In this section, all 442 IPOs are divided into three groups: low, medium, and high, based on the two different underwriter prestige measures. Panel A shows the measure based on the ratio of the total gross proceeds (Prestige_GrossProceeds). The high prestige group consists of 105 IPOs, which are managed by underwriters with a 3 percent or higher Prestige_GrossProceeds. The low prestige group consists of 248 IPOs with a smaller than 1 percent Prestige_GrossProceeds. Panel B shows the measure based on the number of IPOs managed by an underwriter (Prestige_IPOs). The high prestige group consists of 84 IPOs, which are managed by underwriters with 16 or more 'Prestige_IPOs'. The low group consists of 270 IPOs, which are managed by underwriters with nine or lower 'Prestige_IPOs'. The remainders in both panels fall in the medium group. Furthermore, I present the market adjusted initial returns and the three-year BHARs for each group and test the mean sub-samples' differences by using both parametric test statistics (t-stats) and non-parametric test statistics (Kruskal-Wallis Chi2). I use the Kruskal-Wallis non-parametric test statistic because it is robust to deviations of normality, and the sample groups do not have to be equal.

Table 5- Underwriter prestige and the market adjusted returns of 442 German IPOs, 1984-2017

Prestige measures	Initial returns				Three-year BHARs			Prestige groups	Initial returns		Three-year BHARs	
	N	Mean	P50	STD	Mean	P50	STD		t stat	Chi-squared	t stat	Chi-squared
Panel A (Prestige_GrossProceeds):												
Low (Prestige_GrossProceeds<1%)	248	24.95	0.89	117.28	-42.99	-46.26	71.75	Low vs. Medium	-1.29	0.00	-0.32	0.37
Medium (1% ≤ Prestige_GrossProceeds < 3%)	89	60.42	0.48	386.74	-40.12	-38.74	73.56	Medium vs. High	1.23	0.76	0.74	0.60
High (Prestige_GrossProceeds ≥ 3%)	105	13.38	4.00	51.47	-47.52	-45.17	66.43	Low vs. High	0.97	0.85	0.55	0.13
Panel B (Prestige_IPOs):												
Low (Prestige_IPOs ≤ 9)	270	25.30	1.12	117.02	-44.68	-46.21	69.50	Low vs. Medium	-1.14	0.01	-0.84	1.15
Medium (9 < Prestige_IPOs < 16)	88	55.60	0.50	386.15	-37.27	-37.42	77.12	Medium vs. High	0.96	0.38	0.80	1.08
High (Prestige_IPOs ≥ 16)	84	14.83	3.59	50.71	-46.19	-46.40	68.42	Low vs. High	0.80	0.63	0.18	0.06

Panel A and B of table 5 show the descriptive statistics for the market adjusted initial returns and the three year BHARs of 442 German IPOs from 1984 until 2015, categorized by the underwriter prestige measures UR1 and UR2. The market adjusted initial return (IR) is the percentage difference between the offer price and the first trading day closing price, relative to the market return on the DAX Index. The market-adjusted 3-year buy-and-hold return (BHAR3y) is calculated from the listing date +1 through the listing date +726 using the buy-and-hold strategy. SIZE represents the total market capitalization of the IPO company. STD represents the standard deviation of returns for each company and is estimated from a time series of daily raw returns using the listing date +1 through the listing date +26. MARKET represents the average return on the DAX Index for 3 months before offering. Prestige_GrossProceeds is the underwriter prestige ranking variable using the ratio of the gross proceeds raised by each underwriter. Prestige_IPOs is the underwriter prestige ranking variable using the number of IPOs managed by each underwriter. The IRs and BHARs are presented in percentages. Parametric test statistics (t-stats) and non-parametric test statistics (Kruskal-Wallis X2) are conducted to test the differences in sub-sample mean returns. Significance at the 10, 5 and 1 percent levels are indicated with *, ** and ***.

Table 5 shows that the mean market adjusted initial returns of the low prestige groups are positive, with 24.9 percent (Prestige_GrossProceeds) and 25.3 percent (Prestige_IPOs). The medium prestige groups underprice IPOs with 60.4 percent (Prestige_GrossProceeds) and 55.6 percent (Prestige_IPOs). The high prestige groups have initial returns of 13.4 percent (Prestige_GrossProceeds) and 14.8 percent (Prestige_IPOs). These results imply that underwriters, on average, underprice IPOs. Additionally, the high prestige groups show less severe underpricing than the other groups, which is in line with my first hypothesis.

Still, no clear positive/negative relation is shown between the initial returns and underwriter prestige. The parametric and non-parametric tests for differences in the mean market adjusted initial returns in the prestige groups are insignificant. An explanation for the insignificant results can be the high standard deviations, which are all several times larger than the means, indicating that the IPO's initial returns are widespread. Therefore, these results suggest that most investments in IPOs are neither due to underwriter prestige nor by the quality of the IPOs companies. Another explanation can be insufficient supply and high demand for IPOs. When the initial returns are high and mostly positive, investors will invest in IPOs without concern for the underwriter prestige or quality of the IPO companies.

Table 5 shows that the mean three-year BHARs of the low prestige groups are negative, with -42.9 percent (Prestige_GrossProceeds) and -44.7 percent (Prestige_IPOs). The IPOs of the medium prestige groups underperform with -40.1 percent (Prestige_GrossProceeds) and -37.3 percent (Prestige_IPOs). Also, the IPOs of the high prestige groups underperform with -47.5 percent (Prestige_GrossProceeds) and -46.2 percent (Prestige_IPOs). These results imply that IPOs underperform in the long-run. Additionally, the medium prestige groups show less severe underperformance than the low prestige groups, which is in line with my expectations. However, this decreasing underperformance is not constant compared to the high prestige group where the underperformance is worse again. This result is not in line with existing literature and my expectations. Carter et al. (1998) show the means for low, medium, and high prestige groups, respectively -33.8 percent, -26.1 percent, and -12.6 percent, which contradicts my results. An explanation can be that Carter et al. (1998) correct the raw return with the CRSP NYSE/AMEX/Nasdaq value-weighted index returns. Besides, Ritter (1991) uses a matching sample to compare the BHARs of the IPO sample to see if they underperform. In this paper, we use only the DAX index, which can lead to insignificant results.

Still, no clear positive/negative relation is presented between the three-year BHARs and underwriter prestige. The parametric and non-parametric tests for differences in the mean three-year BHARs in the

prestige groups are insignificant. An explanation for these insignificant results can be the high standard deviations, indicating that the three-year BHARs are widespread. Therefore, while the significant negative full sample BHAR implies that investors may incur a loss when holding an IPO, my prestige analysis shows that investing in IPOs with more prestigious underwriters will not significantly mitigate the underperformance. Still, the Pearson correlation in Table 3 shows a positive relation between underwriter prestige and the BHAR, indicating when the underwriter prestige increases, the BHAR increases.

5.3 Cross-sectional OLS regression analyses

5.3.1 Initial return and underwriter prestige

Table 6 shows the results of the cross-sectional OLS regression analyses that use the market adjusted initial return as the dependent variable. Four multivariate regression analyses ((1), (2), (3) and (4)) are conducted with each of the two underwriter prestige measures (Prestige_GrossProceeds or Prestige_IPOs), the big six underwriters apart and combined, and the control variables.

Table 6 – Results of cross-sectional OLS regressions

	(1) IR	(2) IR	(3) IR	(4) IR
Prestige_GrossProceeds	-1.108*	-0.816*		
	(-1.82)	(1.78)		
Prestige_IPOs			-0.008	-0.031
			(-0.43)	(-0.83)
big6	-0.233		-0.413	
	(-0.54)		(-0.96)	
big6_Aktieninvestor AG		0.266		0.517
		(0.29)		(0.95)
big6_Commerzbank AG		-0.233		-0.867
		(-0.26)		(-0.93)
big6_Deutsche Bank AG		-0.467		-1.339
		(-0.64)		(-1.20)
big6_FTI Consulting		0.746**		0.894*
		(1.99)		(1.73)
big6_Deutsche Genossenschaftsbank AG		-0.152		-0.593
		(-0.26)		(-1.01)
big6_Norddeutsche Landesbank Girozentrale		-0.301		-0.377
		(-0.55)		(-1.04)
lnSIZE	-0.107	-0.114	-0.102	-0.106
	(-1.01)	(-1.01)	(-1.08)	(-1.06)
STD	2.284*	2.351*	2.277*	2.234*
	(1.72)	(1.72)	(1.72)	(1.71)
MARKET	153.812***	150.290***	153.562***	150.458***
	(3.12)	(3.12)	(3.06)	(3.05)
1. *Mining and Construction*	1.470	1.531	1.505	1.738
	(0.90)	(0.93)	(0.91)	(1.04)
2. *Manufacturing 1*	0.287**	0.299*	0.343**	0.478**
	(1.97)	(1.71)	(2.29)	(2.10)
3. *Manufacturing 2*	0.261**	0.265*	0.314***	0.455**
	(2.56)	(1.82)	(2.77)	(2.07)
4. *Transportation, Communications, Electric, Gas and Sanitary Service*	0.344**	0.333	0.384**	0.467**
	(2.24)	(1.64)	(2.26)	(2.04)
5. *Wholesale Trade and Retail Trade*	0.441**	0.457**	0.500**	0.637**
	(2.30)	(2.00)	(2.37)	(2.18)
6. *Finance, Insurance and Real Estate*	0.846	0.860	0.900	1.038
	(1.33)	(1.25)	(1.34)	(1.33)
7. *Services 1 (Technology)*	0.699***	0.731***	0.748***	0.928***
	(4.91)	(4.06)	(4.82)	(3.52)
8. *Services 2 (Medical)*	-0.018	-0.003	0.033	0.208
	(-0.08)	(-0.01)	(0.13)	(0.59)
9. *Public Administration*	-0.180	-0.169	-0.098	0.109
	(-0.59)	(-0.63)	(-0.41)	(0.73)
Cons	1.807	1.916	1.630	1.413
	(0.90)	(0.93)	(0.95)	(0.88)
Adj. R2	0.012	0.001	0.013	0.005
N	442	442	442	442

Table 6 presents the results of cross-sectional OLS regression analyses explaining the market adjusted initial returns of 442 German IPOs from 1984 until 2015. The market adjusted initial return (IR) is the percentage difference between the offer price and the first trading day closing price, relative to the market return on the DAX Index. SIZE represents the total market capitalization of the IPO company. STD represents the standard deviation of returns for each company and is estimated from a time series of daily raw returns using the listing date +1 through the listing date +26. MARKET represents the average return on the DAX Index for 3 months before offering. Prestige_GrossProceeds is the underwriter prestige ranking variable using the ratio of the gross proceeds raised by each underwriter. Prestige_IPOs is the underwriter prestige ranking variable using the number of IPOs managed by each underwriter. Big6 are the largest six underwriters of the sample that raise the highest gross proceeds in my sample. All Big6 underwriters are added separately as control variables. Significance at the 10, 5 and 1 percent levels are indicated with *, ** and ***.

Table 6 presents that the Prestige_GrossProceeds measure is significant and has a negative relation of -1.1 percent and -0.8 percent with the market adjusted initial return. This relation means that when the underwriter prestige increases with 1 percent, the market adjusted initial return will decrease with 1.1 or 0.8 percent. The Prestige_IPOs measure shows a negative relation of -0.8 and -3.1 percent with the market adjusted initial return, but these relations are insignificant. Moreover, most of the big six underwriters have a negative relationship with the market adjusted initial return, but these are insignificant. Nonetheless, FTI Consulting has a significant positive relationship with the initial return with both UR1 and Prestige_IPOs, which indicates that a more prestigious underwriter causes the underpricing effect to rise, as stated by Johnston and Roten (2015). An explanation can be that FTI Consulting has only managed one IPO in my sample, Deutsche Telekom AG, which has the most extensive offering size and a high initial return.

On the contrary, I expect a more prestigious underwriter to be associated with lower risks and uncertainty, which would mitigate the initial underpricing effect. Most of these results are consistent with my expectation and the previous literature of Carter and Manaster (1990). Besides, these results are in line with the Pearson correlation in Table 4, which shows a negative relation between initial return and underwriter prestige. So, based on these findings, I accept the first hypothesis H1, which states, "*IPO companies underwritten by prestigious underwriters experience less initial underpricing.*" These results can be due to several reasons: For example, low-risk IPOs seek more prestigious underwriters when going public. More prestigious underwriters select only IPOs with low risks and better performance as they have reputational capital at stake (Chemmanur and Fulghieri, 1994). More prestigious underwriters have more valuation and certification skills, that result in a lower offer price (Titman and Trueman, 1986).

The ex-ante uncertainty (STD) has a significantly positive relation in all the regression analyses with the market adjusted initial return, which is around 2.3 percent. These results indicate that more IPO uncertainty leads to higher market adjusted initial returns and, therefore, a higher underpricing effect. When the ex-ante uncertainty increases with 1 percent, the market adjusted initial returns increase with approximately 2.3 percent. My expectations are the same as Beatty and Ritter (1986), which state that the initial underpricing of an IPO is dependent on the IPO ex-ante uncertainty, as investors do not have all the information about the company and their value. When uncertainty and risks are high, underwriters have to offer a lower offer price to lure investors, which will increase the initial underpricing effect. These findings are significant and, therefore, I accept the second hypothesis, which states, "*IPO companies with a higher level of ex-ante uncertainty experience higher levels of initial underpricing.*"

Moreover, company size has a negative relation with the market adjusted initial return with a value of around 0.1 percent, which is in line with Carter et al. (1998). They show that more established and larger IPO companies are associated with lower risks and, therefore, the market adjusted initial returns are lower. The results are in line with the Pearson correlation in Table 4, which shows a negative relationship between initial return and company size. However, the results for company size are insignificant.

The market return has a significantly positive relationship with the market adjusted initial return with a value of around 152.1 percent, which is in line with the study of Ljungqvist (1997). When the market is performing well, investors have high expectations of the IPOs and are willing to invest more, which will result in higher initial returns. So, when the market increases, the initial underpricing will increase.

Moreover, Table 6 shows the main ten industry sectors, which affect the market adjusted initial returns. The industry with the highest level of significance is number seven, which mostly represents technology companies. These results are in line with Bessler and Bittelmeyer (2008), which state that high-tech companies suffer higher initial underpricing effects as they are associated with more risks and uncertainty. Furthermore, the financial sector, represented with number six, has a positive relation with initial returns, which is not in line with Ritter (1991). These companies are expected to be better in valuation and, therefore, can lower the underpricing effect. Still, the results are not significant.

Lastly, the positive adjusted R-squared values of 1.2, 0.1, 0.13, and 0.5 percent indicate that the model does not fit the data well. The regression analyses have deficient explanatory power, which can be

explained by the high level of insignificant results or mostly low significant results. Also, the size of the sample can be too low for concluding. Still, Carter et al. (1998) show low adjusted R-squares values between 1-3 percent. They have a sample of 2,292 IPOs and show significant control variables, but still, the model has low explanatory power.

5.3.2 Long-run Performance and Underwriter Prestige

Table 7 shows the results of the cross-sectional OLS regression analyses that use the three-year BHAR as the dependent variable. Four multivariate regression analyses ((1), (2), (3) and (4)) are conducted with each of the two underwriter prestige measures (Prestige_GrossProceeds or Prestige_IPOs), the big six underwriters apart and combined, and the control variables.

Table 7 – Results of cross-sectional OLS regressions

	(1) BHAR3y	(2) BHAR3y	(3) BHAR3y	(4) BHAR3y
Prestige_GrossProceeds	4.396*	4.033*		
	(1.77)	(1.72)		
Prestige_IPOs			0.004	0.005
			(0.62)	(0.44)
Big6	-0.308		-0.089	
	(-1.22)		(-0.57)	
Big6_Aktieninvestor AG		-0.692		-0.218
		(-1.08)		(-1.04)
Big6_Commerzbank AG		-0.162		0.055
		(-0.34)		(0.18)
Big6_Deutsche Bank AG		-0.366		-0.214
		(-0.88)		(-0.64)
Big6_FTI Consulting		0.175		0.405**
		(0.56)		(2.55)
Big6_Deutsche Genossenschaftsbank AG		-0.277		-0.126
		(-0.79)		(-0.54)
Big6_Norddeutsche Landesbank Girozentrale		-0.336		-0.208
		(-1.21)		(-1.03)
lnSIZE	0.005	0.007	0.009	0.011
	(0.21)	(0.29)	(0.41)	(0.46)
STD	-0.442*	-0.439*	-0.511*	-0.464*
	(-1.80)	(-1.79)	(-1.84)	(-1.81)
MARKET	-53.987**	-55.451**	-52.518**	-54.667**
	(-2.08)	(-2.15)	(-2.04)	(-2.12)
1. *Mining and Construction*	-0.818***	-0.818***	-0.868***	-0.858***
	(-4.60)	(-4.29)	(-5.08)	(-4.74)
2. *Manufacturing 1*	-0.525***	-0.536***	-0.577***	-0.573***
	(-3.27)	(-3.28)	(-3.79)	(-3.69)
3. *Manufacturing 2*	-0.485***	-0.499***	-0.530***	-0.530***
	(-4.71)	(-4.34)	(-5.82)	(-4.78)
4. *Transportation, Communications, Electric, Gas and Sanitary Service*	-0.423***	-0.420***	-0.451***	-0.455***
	(-3.24)	(-2.72)	(-3.55)	(-3.29)
5. *Wholesale Trade and Retail Trade*	-0.479***	-0.489***	-0.527***	-0.521***
	(-2.83)	(-2.67)	(-3.25)	(-2.99)
6. *Finance, Insurance and Real Estate*	-0.422***	-0.427***	-0.469***	-0.457***
	(-3.84)	(-3.46)	(-4.60)	(-3.93)
7. *Services 1 (Technology)*	-0.466***	-0.466***	-0.516***	-0.500***
	(-4.96)	(-3.79)	(-6.34)	(-4.46)
8. *Services 2 (Medical)*	-0.397**	-0.410**	-0.436***	-0.440***
	(-2.55)	(-2.43)	(-2.77)	(-2.67)
9. *Public Administration*	-0.655***	-0.660***	-0.717***	-0.702***
	(-3.47)	(-3.23)	(-4.10)	(-3.68)
Cons	-0.075	-0.105	-0.091	-0.132
	(-0.18)	(-0.25)	(-0.22)	(-0.31)
Adj. R2	-0.006	-0.015	-0.009	-0.016

Table 7 presents the results of cross-sectional OLS regression analyses explaining the three year BHARs of 442 German IPOs from 1984 until 2015. The three year buy-and-hold return (BHAR3y) is calculated from the listing date +1 through the listing date +726 using the buy-and-hold strategy. SIZE represents the total market capitalization of the IPO company. STD represents the standard deviation of returns for each company and is estimated from a time series of daily raw returns using the listing date +1 through the listing date +26. MARKET represents the average return on the DAX Index for 3 months before offering. Prestige_GrossProceeds is the underwriter prestige ranking variable using the ratio of the gross proceeds raised by each underwriter. Prestige_IPOs is the underwriter prestige ranking variable using the number of IPOs managed by each underwriter. Big6 are the largest six underwriters of the sample that raise the highest gross proceeds in my sample. All Big6 underwriters are added separately as control variables. Significance at the 10, 5 and 1 percent levels are indicated with *, ** and ***.

Table 7 shows that the Prestige_GrossProceeds measure is significant and has a positive relation of 4.4 and 4.0 percent with the three-year BHAR. This relation means that when the underwriter prestige increases with 1 percent, the three-year BHAR will increase with 4.4 or 4.0 percent. The Prestige_IPOs measure shows a positive relation of 0.4 and 0.5 percent with the three-year BHAR, but this relation is insignificant. These results are in line with the study of Carter et al. (1998), which present a positive relationship between the underwriter prestige and the long-run IPO performance. When selecting an underwriter, more established and larger companies tend to associate themselves with more prestigious underwriters. These companies have less uncertainty with higher valuation qualities and, therefore, the expected long-run performance is more accurately met. Besides, the Pearson correlation in Table 4 shows a positive relationship between the three-year BHAR and both underwriter prestige measures. These findings have led to the fourth hypothesis's acceptance, which states, "IPOs underwritten by more prestigious underwriters experience better long-run performance."

Moreover, the ex-ante uncertainty (STD) has a significantly negative relation in all the regression analyses with the three-year BHARs with values from -0.4 to -0.5 percent. These results indicate that more IPO uncertainty leads to a lower three year BHAR and, therefore, IPOs underperform more in the long-run. When the ex-ante uncertainty increases with 1 percent, the three-year BHARs decrease with approximately 0.4 percent. These results are in line with Johnson and Miller (1988), which show a negative relation between the three-year BHAR and the ex-ante uncertainty. They state that the long-run performance is entangled with the expectations of the investors. Investors who invest in IPOs with more uncertainty, have higher expectations about the returns, which are challenging to accomplish and, therefore, underperform to the expectations in the long-run. Hence, based on these findings, I accept the fifth hypothesis, which states, "IPO firms with higher levels of ex-ante uncertainty experience long-run underperformance."

Furthermore, Table 7 shows a small positive relationship between the size and three-year BHARs. These results are in line with Carter et al. (1998), which show that more established and larger IPO companies have lower information asymmetry and, therefore, perform better in the long-run. Still, the results are not significant.

Moreover, the market return has a significantly negative relationship with the three-year BHARs, with approximately -53 percent, which is in line with Loughran and Ritter (1995). When the market is performing well, investors have high expectations of the IPOs and are willing to invest more, which will result in higher initial returns. This overvaluation is than corrected by the aftermarket as the expectations have been too high and, therefore, the long-run performance is lower.

Subsequently, Table 7 shows the main ten industry sectors which affect the three-year BHARs. All the industries have a significantly negative relationship with long-run performance. These negative relations show that almost all companies, even underwritten by high prestige underwriter or low prestige underwriter, in my sample, are underperforming in the long-run. These results are not expected as all industries underperform in the long-run. I expected IPOs in the financial industry to perform better in the long-run as they have high-quality certification skills. However, I expected the technology companies, with SIC number seven, to underperform in the long-run, since these companies are challenging to evaluate and have more uncertainty. Therefore, these companies have more problems to perform according to expectations.

Lastly, the negative adjusted R-squared values of -0.6, -1.5, -0.9, and -1.6 percent show that the model has low explanatory powers and does not fit well with the data.

5.4 Robustness Tests

Table 8 – Robust results of underwriter prestige and market adjusted returns of 442 German IPOs

	Prestige_GrossProceeds	Prestige_IPOs	Market adjusted initial returns			Market adjusted 3-year BHARs		
			Mean	Median	STD	Mean	Median	STD
Panel A:								
Aktieninvestor	0.12	1.00	0.16	0.16		-0.63	-0.63	
Commerzbank	0.09	28.00	0.24	0.01	0.68	-0.31	-0.37	0.91
Deutschebank	0.08	35.00	0.06	0.05	0.35	-0.54	-0.55	0.41
FTI-consulting	0.06	1.00	0.99	0.99		-0.26	-0.26	
Genossenschaft	0.06	21.00	0.18	0.05	0.47	-0.54	-0.50	0.69
NDLG	0.04	9.00	-0.01	0.13	0.45	-0.62	-0.51	0.62
Panel B:								
Big6	0.08	26.66	0.14	0.04	0.50	-0.48	-0.48	0.67
Others	0.01	5.74	0.33	0.01	2.20	-0.42	-0.44	0.72
t_stat			0.85			0.64		
Chi2			1.10			0.40		

Panel A of Table 8 shows the descriptive statistics for the market adjusted initial returns and three year BHARs for 216 IPOs underwritten by the largest six underwriters measured by underwriter prestige measure Prestige_GrossProceeds from 1984 until 2015. Aktien, Commerz, Deutsche, FTI, Genossen and Nordd are the six largest underwriters that raised the highest gross proceeds in my sample. Parametric test statistics (t-stats) and non-parametric test statistics (Kruskal-Wallis X2) are conducted to test the differences in sub-sample mean returns. Significance at the 10, 5 and 1 percent levels are indicated with *, ** and ***.

In panel A of Table 8, we see the initial returns and the long-run performance of the IPOs managed by the six largest underwriters based on the two measures. The Big six underwriters are Aktieninvestor AG, Commerzbank AG, Deutsche Bank, FTI Consulting, Deutsche Genossenschaftsbank AG and Norddeutsche Landesbank Girozentrale. These six underwriters manage 216 IPOs of the total sample. Furthermore, panel B shows no significant difference between the mean market adjusted initial returns of the big six underwriter IPOs and the other IPOs (t-stat = 0.86 and Kruskal-Wallis Chi2 = 1.10). The table shows the same results for the long-run performance means of the big six underwriter IPOs and the others with low reputation underwriters (t-stat = 0.64 and Kruskal-Wallis Chi2 = 0.40). These tests show no significant difference in the mean ranks of the big six versus the others, which indicates that no sample group stochastically dominates the other sample group.

Figures 1 and 2 below, present and compare the average market-adjusted initial returns and three-year BHARs of German IPOs underwritten by the largest six underwriters versus the others, in terms of the listing year. In Figure 1, we see that, on average, the largest six underwriters have a lower market adjusted initial return compared to others, which means that IPOs underwritten by more prestigious underwriters have higher initial underpricing. Still, the initial returns are very inconsistent over the

years. Moreover, Figure 2 shows that the IPOs managed by the largest six underwriters have severe underperformance every year, except for 2002. Besides, the average three-year BHAR over the years is less negative compared to others, indicating that IPOs underwritten by more prestigious underwriters perform less severe in the long-run. Still, the results are inconsistent over the years.

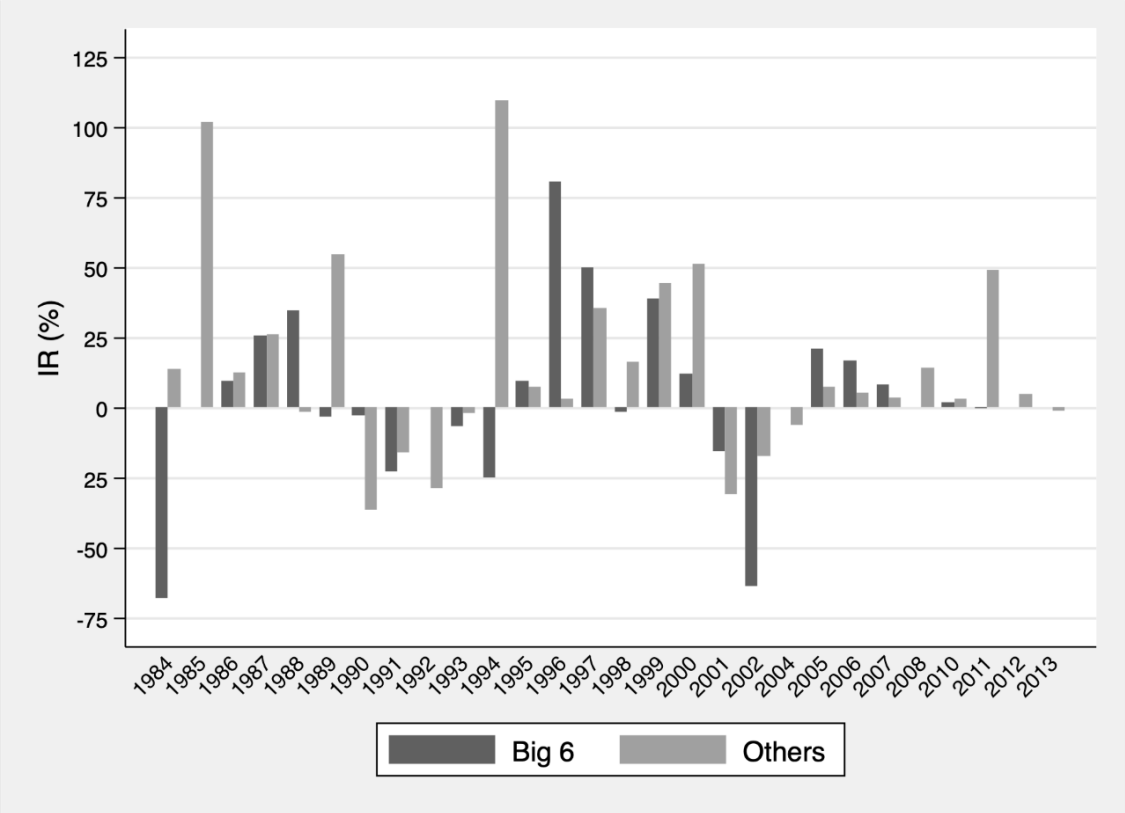

Figure 1 – The market adjusted initial returns of IPOs managed by the big 6 underwriters versus the others, in terms of listing year.

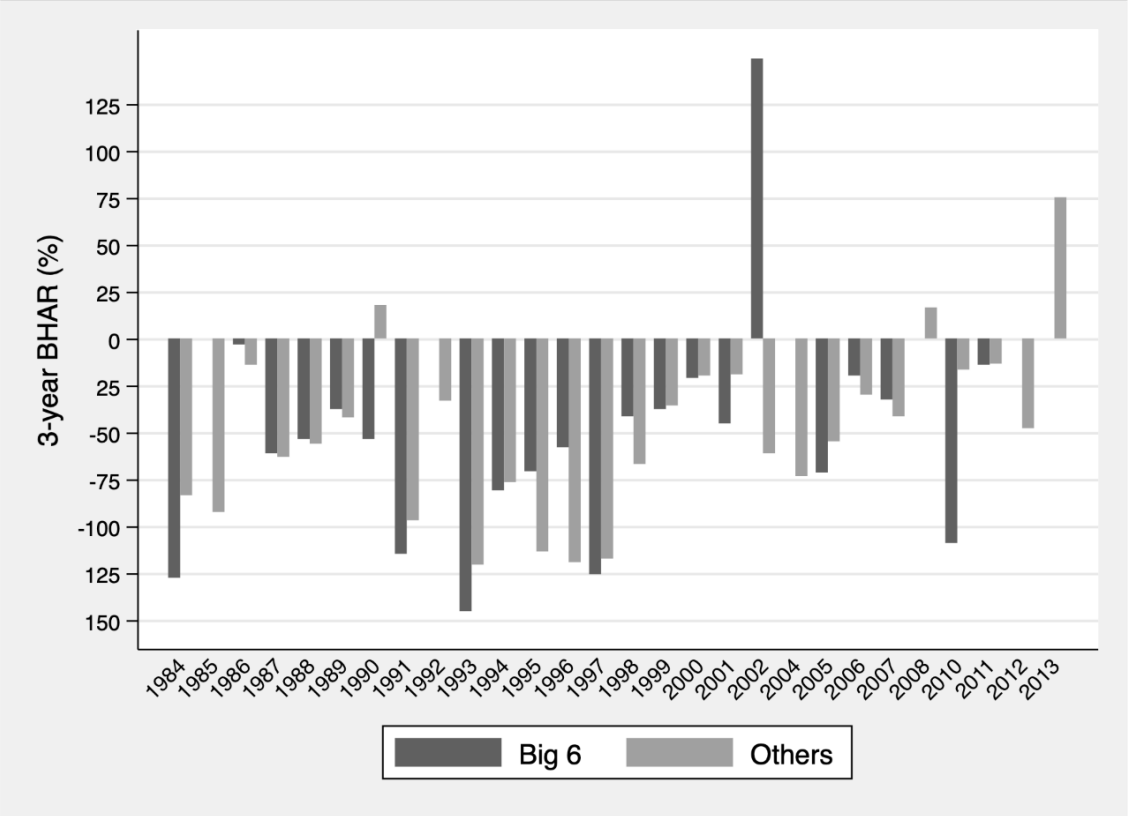

Figure 2 – The market adjusted three year BHARs of IPOs managed by the big 6 underwriters versus the others, in terms of listing year.

6. Conclusion

This thesis examines the impact of the underwriter prestige on the short- and long-run performance of German IPOs. My sample exists of 442 IPOs issued in Germany between 1984 and 2015. To analyze the underwriter prestige's impact, I have used two alternative proxies to measure this prestige, based on the ratio of the total gross proceeds raised or the number of IPOs managed by underwriters over the entire sample. The underwriter prestige measures are divided into three sample groups: low, medium, and high prestige.

Subsequently, I examined the IPO performance based on the three sample groups. I also discussed the market adjusted initial returns and the long-run performance of IPOs and the impact of the two underwriter prestige measures on them.

To account for several factors of IPO underpricing and the long-run performance, I have included several control variables based on previous literature. I control both for the size of the IPO company, ex-ante uncertainty, the market return, and industry effect.

Moreover, I can verify the severe underpricing effect and long-run underperformance of IPOs compared to the market benchmark as the mean market adjusted initial return and mean three-year BHAR are 29.3 and -43.5 percent. These results are consistent with previous literature such as Carter et al. (1998) and Ljungqvist (1997).

Furthermore, I find that only the Prestige_GrossProceeds measure is significantly positively related to the market adjusted initial return, which is in line with Carter and Manaster (1990). They state that the initial underpricing is less severe for IPOs, as more prestigious underwriters manage low-risk companies. Also, the significantly positive relation between the ex-ante uncertainty and the initial return confirms this finding. Besides, Chemmanur and Fulghieri (1994) state that more prestigious underwriters manage less risky companies as their reputational capital is at stake. Still, it is also possible that more established companies with low risk seek more prestigious underwriters (Carter et al., 1998).

Furthermore, the mean initial return of the high prestige group is lower compared to the other two prestige groups, indicating that the underpricing effect is less severe when underwritten by a more prestigious underwriter. However, the results are insignificant. These insignificant results can be explained by insufficient supply and high demand for IPOs, which stimulates investors to invest in IPOs without concern about the quality of the IPO or underwriter prestige.

Subsequently, I find a significantly positive relationship between the Prestige_GrossProceeds measure and the three-year BHAR, which is consistent with Carter et al. (1998). They show that more established low-risk IPO companies associate themselves with more prestigious underwriters and, therefore, underperform less severe in the long-run. Also, the significantly negative relation between ex-ante uncertainty and the three-year BHAR supports this finding. Still, the mean three-year BHARs of the high prestige group is negatively larger compared to the other prestige groups, indicating that IPOs underwritten by more prestigious underwriters underperform more. Yet, the results are insignificant for these groups. The same explanation as before can elaborate on these insignificant results in comparing the prestige groups.

Moreover, the market return has a significantly positive relationship with the market adjusted initial return and negative relation with the three-year BHAR. Both are in line with expectations. When the market performs well, and the expectations are high, investors are willing to invest more and take risks, which will increase the initial underpricing effect. The aftermarket corrects this high sentiment about future expectations as more information becomes available, that will result in lower long-run performance.

Overall, underwriter prestige has an impact on the short- and long-run performance of German IPOs. When a more prestigious underwriter underwrites an IPO, the initial underpricing becomes lower. Also, IPOs perform better in the long-run, when underwritten by a more prestigious underwriter. The uncertainty of an IPO can explain both relations; as the uncertainty increases, the initial underpricing becomes higher, and the long-run performance becomes lower. Yet, it is not clear if these outcomes are since more established companies search for more prestigious underwriters, or that more prestigious underwriters look for better targets as they have their reputational capital at stake.

Furthermore, venture capitalists, private equity companies, entrepreneurs should not only look to associate themselves with more prestigious underwriters but also should wait until they have grown enough to and is less risky when going public. In addition, short-term investors should invest in smaller companies with higher risk levels and, therefore, higher initial returns. Investors with a long-term vision should focus more on IPO companies with low risk and less on the underwriter prestige status.

6.1 Discussion

The reader should account for some limitations when he interprets the results of this thesis. First, I have constructed two uniform measures of underwriter prestige, which account for the fact that underwriters have accumulated prestige and have specific knowledge in the domestic stock market. Even so, I did not include extensive underwriting skills and activities in other markets. These measures could underestimate some underwriters' prestige and the quality of their services, particularly for underwriters operating internationally, such as Goldman Sachs or J.P. Morgan. These underwriters have accumulated a lot of reputational capital and prestige because of their strong presence in the American market, but not as strong in Europe. Secondly, my sample and analysis are based on the accuracy of the databases where I collected my data, such as Thomson One, Zephyr, and Orbis. Thirdly, the sample size is relatively small for the sample period. From 1984 until 2015, I have collected 442 German IPOs. In such a relatively small sample, extreme values can have an enormous impact on the results. Fourthly, the adjusting of the long-run performance with the appropriate market index is essential for the results. The DAX index may be performing too well compared to the IPO sample, which causes the all IPO companies to underperform. The method of Ritter (1984), using a comparable sample of companies to adjust, could change the results. Lastly, the R-squared values of the regression analyses were low. These low values mean that the model does not fit my data well, and the explanatory power is low. The missing control variables can be a reason for the low value. Overall, as recommendations, the above limitations can be taken into account for further research.

Reference List

Akerlof, George A., (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism, The Quarterly Journal of Economics, Oxford University Press, vol. 84(3), pages 488-500.

Aggarwal, R., & Rivoli, P. (1990). Fads in the Initial Public Offering Market? Financial Management, 19(4), 45. https://doi.org/10.2307/3665609

Alli, K., Yau, J., & Yung, K. (1994). THE UNDERPRICING OF IPOS OF FINANCIAL INSTITUTIONS. Journal of Business Finance & Accounting, 21(7), 1013–1030. https://doi.org/10.1111/j.1468-5957.1994.tb00361.x

Beatty, R. P., & Ritter, J. R. (1986). Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics*, *15*(1–2), 213–232. https://doi.org/10.1016/0304-405x(86)90055-3

Bessler, W., & Bittelmeyer, C. (2008). Patents and the performance of technology firms: Evidence from initial public offerings in Germany. *Financial Markets and Portfolio Management*, *22*(4), 323–356. https://doi.org/10.1007/s11408-008-0089-3

Bessler, W., & Thies, S. (2007). The long-run performance of initial public offerings in Germany. *Managerial Finance*, *33*(6), 420–441. https://doi.org/10.1108/03074350710748768

Bomans, R.B. 2009. "IPO underpricing in Europe; a comparison between technology and non-technology IPOs." Retrieved from http://dare.uva.nl/cgi/arno/show.cgi?fid=143696.

Carter, R. B., Dark, F. H., & Singh, A. K. (1998). Underwriter Reputation, Initial Returns, and the Long-Run Performance of IPO Stocks. *The Journal of Finance*, *53*(1), 285–311. https://doi.org/10.1111/0022-1082.104624

Carter, R., & Manaster, S. (1990). Initial Public Offerings and Underwriter Reputation. *The Journal of Finance*, *45*(4), 1045–1067. https://doi.org/10.1111/j.1540-6261.1990.tb02426.x

Chemmanur, T. J., & Fulghieri, P. (1994). Investment Bank Reputation, Information Production, and Financial Intermediation. *The Journal of Finance*, *49*(1), 57–79. https://doi.org/10.1111/j.1540-6261.1994.tb04420.x

Cliff, M. T., & Denis, D. J. (2004). Do Initial Public Offering Firms Purchase Analyst Coverage with Underpricing? *The Journal of Finance*, *59*(6), 2871–2901. https://doi.org/10.1111/j.1540-6261.2004.00719.x

Derrien, F., & Womack, K. L. (2003). Auctions vs. Bookbuilding and the Control of Underpricing in Hot IPO Markets. *Review of Financial Studies*, *16*(1), 31–61. https://doi.org/10.1093/rfs/16.1.0031

Dong, M., Michel, J.-S., & Pandes, J. A. (2011). Underwriter Quality and Long-Run IPO Performance. *Financial Management*, *40*(1), 219–251. https://doi.org/10.1111/j.1755-053x.2010.01140.x

Ellis, K., Michaely, R., & O'Hara, M. (2000). When the Underwriter Is the Market Maker: An Examination of Trading in the IPO Aftermarket. *The Journal of Finance*, *55*(3), 1039–1074. https://doi.org/10.1111/0022-1082.00240

Goergen, M., Khurshed, A., & Mudambi, R. (2007). The long-run performance of UK IPOs: can it be predicted? *Managerial Finance*, *33*(6), 401–419. https://doi.org/10.1108/03074350710748759

Ibbotson, R. G., & Ritter, J. R. (1995). Chapter 30 Initial public offerings. *Handbooks in Operations Research and Management Science*, 993–1016. https://doi.org/10.1016/s0927-0507(05)80074-x

Johnson, J. M., & Miller, R. E. (1988). Investment Banker Prestige and the Underpricing of Initial Public Offerings. *Financial Management*, *17*(2), 19. https://doi.org/10.2307/3665523

Johnston, J., & Roten, I. (2015). The Changing Influence of Underwriter Prestige on Initial Public Offerings. *Journal of Finance and Economics*, *3*(3), 26–37. https://doi.org/10.12735/jfe.v3i3p26

Ljungqvist, A. P. (1997). Pricing initial public offerings: Further evidence from Germany. *European Economic Review*, *41*(7), 1309–1320. https://doi.org/10.1016/s0014-2921(96)00035-9

Logue, D. E. (1973). On the Pricing of Unseasoned Equity Issues: 1965-1969. *The Journal of Financial and Quantitative Analysis*, *8*(1), 91. https://doi.org/10.2307/2329751

Logue, D. E., Rogalski, R. J., Seward, J. K., & Foster-Johnson, L. (2002). What Is Special about the Roles of Underwriter Reputation and Market Activities in Initial Public Offerings? *The Journal of Business*, *75*(2), 213–243. https://doi.org/10.1086/338702

Loughran, T., & Ritter, J. R. (2002). Why Has IPO Underpricing Changed Over Time? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.331780

Loughran, T., Ritter, J. R., & Rydqvist, K. (1994). Initial public offerings: International insights. *Pacific-Basin Finance Journal*, *2*(2–3), 165–199. https://doi.org/10.1016/0927-538x(94)90016-7

Lowry, M., & Schwert, G. W. (2004). Is the IPO pricing process efficient? *Journal of Financial* Economics, 71(1), 3–26. https://doi.org/10.1016/s0304-405x(03)00205-8

Lyon, J., Barber, B. and Tsai, C. 1999, 'Improved methods of tests of long- horizon abnormal stock returns', Journal of Finance, vol. 54, pp. 165-201.

MEGGINSON, W. L., & WEISS, K. A. (1991). Venture Capitalist Certification in Initial Public Offerings. *The Journal of Finance*, *46*(3), 879–903. https://doi.org/10.1111/j.1540-6261.1991.tb03770.x

Miller, R. E., & Reilly, F. K. (1987). An Examination of Mispricing, Returns, and Uncertainty for Initial Public Offerings. *Financial Management*, *16*(2), 33. https://doi.org/10.2307/3666001

RITTER, J. R. (1984). Signaling and the Valuation of Unseasoned New Issues: A Comment. *The Journal of Finance*, *39*(4), 1231–1237. https://doi.org/10.1111/j.1540-6261.1984.tb03907.x

RITTER, J. R. (1991). The Long-Run Performance of initial Public Offerings. *The Journal of Finance*, *46*(1), 3–27. https://doi.org/10.1111/j.1540-6261.1991.tb03743.x

Ritter, J. R., & Welch, I. (2002). A Review of IPO Activity, Pricing and Allocations. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.296393

Rock, K. (1986). Why new issues are underpriced. *Journal of Financial Economics*, *15*(1–2), 187–212. https://doi.org/10.1016/0304-405x(86)90054-1

Sapusek, A. (2000). Benchmark-Sensitivity of IPO Long-Run Performance: An Empirical Study for Germany. *Schmalenbach Business Review*, *52*(4), 374–405. https://doi.org/10.1007/bf03396626

Schuster, J. A. (2003). The Cross-Section of European IPO Returns. *London School of Economics and Political Science*, 1–43. Geraadpleegd van http://eprints.lse.ac.uk/24860/

Shiller, R. J. (1990). Speculative Prices and Popular Models. *Journal of Economic Perspectives*, *4*(2), 55–65. https://doi.org/10.1257/jep.4.2.55

Stehle, R., Ehrhardt, O., & Przyborowsky, R. (2000). Long-run stock performance of German initial public offerings and seasoned equity issues. *European Financial Management*, *6*(2), 173–196. https://doi.org/10.1111/1468-036x.00119

Titman, S., & Trueman, B. (1986). Information quality and the valuation of new issues. *Journal of Accounting and Economics*, *8*(2), 159–172. https://doi.org/10.1016/0165-4101(86)90016-9

Uhlir, H. (1989). Going Public in the F.R.G. *A Reappraisal of the Efficiency of Financial Markets*, 369–393. https://doi.org/10.1007/978-3-642-74741-0_22

Wang, J., Liu, S., & Wu, C. (2003). Does Underwriter Reputation A ect the Performance of IPO Issues? *The Journal of Entrepreneurial Finance*. Geraadpleegd van https://digitalcommons.pepperdine.edu/cgi/viewcontent.cgi?article=1217&context=jef

Wasserfallen, W., & Wittleder, C. (1994). Pricing initial public offerings. *European Economic Review*, *38*(7), 1505–1517. https://doi.org/10.1016/0014-2921(94)90023-x

Zhang, F. (2012). Information Precision and IPO Pricing. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1596976