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IPO underpricing and the (long-term) relationship between issuers, investors and underwriters

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PREFACE AND ACKNOWLEDGEMENTS

When I write this, I am working on the last version of my thesis. Due to an internship it took 6 months longer than I expected, to finish it. This thesis is the final exercise of my studies. Therefore, I tried to incorporate much of the knowledge I gained in the past 4.5 years in this thesis. The subject of this thesis is about IPO underpricing. Although my future is not in the underwriting business or related to issuing shares (I am going to start my career as an M&A associate), I found this subject interesting. It has been a difficult journey at times. During my internship, I could not always find enough time to work on the thesis. However, I managed to keep it going. After my internship, I could devote my entire schedule to writing the thesis, and in that period it advanced quickly. Now I am finishing it sooner than I expected. It has been a very interesting and educational journey. I would like to thank dr. Lemmen for his guidance in the process. His input and feedback really helped to make this thesis better. I also want to thank my parents, family, friends and (future) colleagues for their support and proofreading. With these words, I am finishing my thesis and with that, I am finishing my studies. Soli Deo Gloria!

ABSTRACT

This thesis researches a potential long-term relationship between issuers and underwriters of Initial Public Offerings (IPOs). In the sample of US offerings in the period 2000-2018, an average amount of underpricing of 6.47% is found. This underpricing can be explained by a set of controls. This amount of underpricing has a negative impact on underwriter market share, although this effect is small and loses statistical significance when lags of market share are included. The results also show that higher underpricing negatively impacts the probability of rehiring in a Follow-on offering. This effect remains significant if underwriter prestige and stabilization practices are taken into account. Lastly, it is shown that the sample contains some IPO waves. In wave years, underwriters have a lower probability of being rehired. Altogether, this thesis proves that the long-term relationship between issuer and underwriter is negatively impacted if underwriters underprice too much in the offerings.

Keywords:
IPOs, SEOs, capital structure, initial returns, underwriters

JEL Classification:
C12, C58, D81, G11, G12, G21, L22, O51

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CHAPTER 1 Introduction

1.1 Introduction

This thesis will focus on the long-term relationship between issuers and underwriters in Initial Public Offerings (IPOs). IPOs seem to be systematically underpriced. For example, Loughran and Ritter (1995) find an average underpricing of 7.4% for US IPOs over a three-year holding period and 7% over a five-year holding period. Ritter and Welch (2002) report for 6,249 US IPOs an average first-day return (first-day return and underpricing are used interchangeably in the literature) of 18.8% in the period 1980-2001. The systematic underpricing found on IPOs can have many reasons. Some explanations focus on information asymmetry between the issuer and the investors (Beatty & Ritter, 1986). Other theories look at activities of the underwriter, such as stabilization practices or the pleasing of investors (Wilhelm Jr, 1999). Since underwriters need to satisfy both the need of the issuer to raise as much capital as possible and the need of the investors to get the best possible deal, there is a potential conflict. Which side do underwriters choose? Do they choose the side of the investors or the side of the issuers? This thesis will attempt to shed more light on the choice underwriters make in this matter by looking at the long-term relationship between issuer and underwriter. If this relationship is strong, it could indicate that underwriters choose the side of the issuer. If the relationship is weak, the opposite may be true. I will look at this relationship by examining if issuers choose the same underwriter(s) for any Seasoned Equity Offering (SEO) or Follow-on as they did for their IPO. This relationship is determined by the amount of underpricing for the IPO, but also by other tasks of the underwriter, for example by creating liquidity in the after-market through stabilization practices. The main research question for this thesis is:

Is there a long-term relationship between issuer and underwriter?

1.2 Relevance

There has been a lot of research on IPO underpricing, as can be seen in the literature review, found in section 2. Virtually all possible explanations are studied already. Therefore, I try to focus more on the implications of underpricing. I try to explain the underpricing by looking at the long-term relationship between issuers, underwriters and investors. But then I take it one step further and I attempt to look what the effects could be of this underpricing, will it change the relationships or will it not. Besides that, I have a large sample period of 18 years, allowing me to study many IPOs and Follow-ons. This long sample period should also give an idea if there is cyclicality in IPOs or not. Lastly, since the financial crisis in 2008 is in the sample period, this thesis could add to the existing literature by examining if the IPO landscape has changed ever since, or that this crisis has impacted underpricing or cyclicality.

1.3 Main results

The sample of offerings in the period spanning from 2000 to 2018 in the United States shows an average amount of underpricing of 6.47%. This underpricing can be explained by a set of controls, split in controls for firm uncertainty and for market conditions. The underpricing has a negative impact on underwriter market share. Adding lags of market share itself, however, shows that market share is persistent over time and that underpricing loses its significance. Higher underpricing negatively impacts the probability of rehiring in a Follow-on offering. Adding market share and a proxy for stabilization practices in previous offerings does not change the significance of the effect of underpricing. Market share and stabilization practices have a positive impact on the probability of rehiring. Lastly, it is determined that the period has some IPO waves, as found by looking at the number of offerings and underpricing itself. In these wave years, underwriters have a lower probability of being rehired as underwriter.

1.4 Structure of the paper

The thesis is structured as follows: first in section 2, I provide an overview of the existing literature on IPOs and IPO underpricing. Section 3 presents the data collection process and the methodology used to answer the research question. In section 4, I describe the results. Section 5 concludes.

CHAPTER 2 Literature review

2.1 IPO underpricing

The first documentation of a systematic underpricing of IPOs happens around the 1970s. Reilly and Hatfield (1969) find significant evidence of underpricing for 53 US issues in the period 1963-1966. Stoll and Curley (1970) find a larger short-term positive return for newly listed stock compared to larger, established stocks. In the long-run, these stocks underperform the larger stocks, but in the short-term they appreciate quickly, which suggests that the role of underwriters, investors and issuers should be researched. McDonald and Fisher (1972) find in their sample of 142 IPOs in 1969 an average underpricing in the first week of 28.5%. Logue (1973) finds a similar result, while Reilly (1973) provides additional results that confirm and extend the short-run results of Stoll and Curley (1970). Two years later, Ibbotson also finds a positive mean initial performance of new stocks (Ibbotson, 1975). In 1987, Chalk and Peavy (1987) examine IPOs and split the sample up in price categories. They find that the underpricing is the highest for lower offer prices, namely in the category $0.01-$1. When the offer price gets higher, underpricing tends to decrease. They also find that the lowest offer price group accounts for the large cumulative abnormal return for 190-day aftermarket performance (Chalk & Peavy III, 1987). In this thesis, all issues with an offer price below five dollars are excluded. In 1982-1983, average underpricing in the US was 9.87% (Miller & Reilly, 1987). Over the period 1986-2014, average US underpricing was 18.1%. It is shown that underpricing is lower in rural areas compared to urban areas. This can be contributed to local bias in rural areas. Investors in rural areas are more likely to invest in local companies, thereby creating a stronger incentive to gather information about those companies, lowering information asymmetry (Nielsson & Wójcik, 2016). In more recent years, research has been done to find out what the reasons could be for this underpricing phenomenon. Since the 1980s, there have been a few ups and downs in the average magnitude of underpricing. Where the average initial return of IPOs was 7% in the 1980s, it is risen to 12% when measured in the period 2001-2003. In between there, have been some jumps, where the first-day return peaked at 65% during the internet bubble (Loughran & Ritter, 2004). Loughran and Ritter attribute this increase to a changing issuer objective function. This function proposes two reasons for underpricing of an IPO. First, there is the analyst lust hypothesis which states that issuers find it more important to consider analyst coverage in choosing a lead underwriter. Issuers find it more important to hire a lead underwriter with a higher ranked analyst to cover the firm. Issuers pay for the indirect costs of analyst coverage by a higher amount of underpricing, because underwriters do not charge direct fees for this coverage. Secondly, there is the spinning hypothesis. This hypothesis states that venture capitalists and the executives of offering firms are co-opted through the allocation of ‘hot’ IPOs to their personal brokerage accounts. They would act as investors on other IPOs, on which they can earn money through the high amount of underpricing on those hot issues. This gives an incentive for decision-makers to choose a lead underwriter which has a reputation of leaving money on the table in IPOs. Although the underpricing of their own IPO lowers the wealth of decision-makers, through the excessive dilution that results from underpricing, they are willing to take this loss because it can be

offset by gains on their personal accounts when other hot IPOs are allocated to them (Loughran & Ritter, 2004). They would be losing wealth by the underpricing on the IPO of the firm they own, but earn this money back while acting as an investor on other IPOs. This 'spinning' used to be a common way of attracting new clients for underwriters. But spinning is prohibited in the US since 2003. Now underwriters need to find a different way to attract (or keep) clients. Guo, Lev and Shi (2006) find that the average underpricing in the period 1980-1995 is 15% for the US. In the period 2001-2004 average US underpricing is 10.99%, according to Dolvin and Jordan (2008). Booth and Chua (1996) suggest that underpricing in IPOs is a positive function of ownership in the presence of costly information. The explanation Booth and Chua give, is not mutually exclusive of previous explanations of underpricing based on adverse selection, information collection or signalling caused by information asymmetry. Although the nature and magnitude of underpricing changes over time, it appears to be a persistent phenomenon. The first hypothesis I want to test therefore is:

H1: There is a significant underpricing in US IPOs in the period 2000-2018.

2.2 Possible explanations of underpricing

2.2.1 Legal reasons

Engelen and Van Essen (2010) show that firms issuing an IPO in countries with a legal system that is more developed, experience a significantly lower magnitude of underpricing. It appears that underpricing is larger in countries were outside investors are stronger protected. This suggests that incumbent managers try to safeguard their private benefits of control when going public through underpricing. Underpricing is also reduced when stronger law enforcement and more readily available accounting information reduces the value of private benefits of control (Hopp & Dreher, 2013). It could be that there are tax reasons for underpricing. For example, in Sweden, it is common practice to state the rationing device in the prospectus. The high amount of underpricing and the extensive employee participation in the buying of the IPO shares attracted the attention of regulators. After the authorities updated the law, which reduced the incentive to sell underpriced shares to employees, the average underpricing experienced a massive drop. This could indicate that underpricing is a substitute for wages. The first step the regulators took was to tax underpricing as ordinary income, not as a capital gain, because underpricing could be attributable to the tax advantage of capital gains tax over ordinary income tax. Second, they prohibited employees to buy more than one unit of the IPO (a unit ranges from 25 to 1000 shares). Indeed, after the new regulation, the underpricing was significantly lower. The tax effect (the situation before the new regulation) contributes for 10.1% to underpricing (Rydqvist, 1997). Taranto (2003) confirms this argument by finding that stock option use has a positive relationship with underpricing. The tax advantage from earning on underpricing outweighs the dilution of the shares due to the issue for managers who own stock options (Taranto, 2003). It is not likely that legal and tax reasons explain underpricing fully, but from evidence it is clear that they play a role in explaining a part of the cross-sectional variation in underpricing.

2.2.2 Signalling and asymmetric information

Issuers may want to underprice their issue, because they can use the jump in the stock price on the first trading day as a way to signal quality to the market (Griffith, 2003). Signalling through underpricing in an IPO is very costly, since it results in a transfer of wealth from the owners to the investors. But, when the information which is contained in the IPO signals is incorporated in the stock price after the IPO, signalling high-quality firms are better and higher valued than non-signalling firms. Hence, initial owners of these high-quality firms can earn IPO signalling costs back by selling their retained shares at the higher, better informed, stock price, and/or by benefiting from an ex ante increase in firm value caused by the decrease of adverse-selection problems the firm may encounter in the SEO market (Espenlaub & Tonks, 1998). Allen and Faulhaber (1989) develop a model in which a firm is better informed about its prospects than anyone else. They show that underpricing can signal favourable prospects for the firm (Allen & Faulhaber, 1989). However, Espenlaub and Tonks (1998) have tested this model by looking at post-IPO behaviour of initial owners and conclude that there is no evidence on the relation between post-IPO share issuance or insider selling and the retained proportion of equity by original owners at the IPO. And, although underpricing is not positively related to the probability of IPO firms to conduct another equity offering, underpricing is proven to be of explanatory power of the volumes of proceeds raised in further equity offerings (Espenlaub & Tonks, 1998).

There is of course asymmetric information in an IPO. Only the owners know the firms true value, where investors do not know this. The investors would want to be compensated for such uncertainty, which could explain underpricing. Where Allen and Faulhaber (1989) show that firms can exploit asymmetric information through the signalling of favourable prospects, Campbell and Kracaw (1980) study if a market with asymmetric information can identify the true value of assets. Their conclusion is that, although markets are able to produce the information needed for such a task, the markets will not come to a Rational Expectations Equilibrium. They argue that the underlying reason for this is that efficient information producers may not have a sufficient stake in the market to persuade the market of their reliability (Campbell & Kracaw, 1980). This may lead to different insight in the explanation of underpricing. An underwriter faces a 'loyalty trade off'. On the one hand, there is the firm which wants to maximize the proceeds from an IPO but on the other hand there are the investors that want the lowest price possible. This leads to a trade-off for underwriters. They must choose which party they want to satisfy the most. It could very well be that that are the investors instead of the issuing firms.

Baron (1982) built a model explaining underpricing by the information asymmetry between investors and issuers. His model assumes that investment bankers are better informed than issuers about prevailing conditions in the market. The issuer will delegate the offer price decision to the banker and because the issuer cannot perfectly monitor the banker, underpricing will occur (Baron, 1982). Muscarella and Vetsuypens (1989) test this model by looking at self-marketed IPOs, i.e. initial public offerings of

investment bankers who market their own securities. According to the model of Baron, this should lead to no underpricing, since underwriter and issuer are the same, meaning that there is no information asymmetry. Their findings, however, contradict Baron's model. They find a statistically significant underpricing of around 7 percent (Muscarella & Vetsuypens, 1989). This means that underpricing cannot fully be explained by the information asymmetry between underwriters and issuers.

2.2.3 Role of the underwriter

In an IPO, investment bankers serve as intermediaries between capital seeking firms and investors who are able to provide the needed capital. In IPO markets, the demand for intermediaries arises because of asymmetric information. Issuers know more about their prospects than investors, where investors on their part know more about the terms on which they want to provide the capital needed. Both parties have an incentive to protect their informational advantage, but the behaviour originating from this advantage drives issuers and investors apart. This creates the need for intermediaries (Wilhelm Jr, 2005). This leads to another explanation of IPO underpricing which could be linked to the winner's curse. This theory assumes that there are investors who are better informed about the true value of the shares to be issued, than investors in general, or the issuing firm, or its underwriting bank. These informed investors only bid for attractively priced offerings. This imposes a 'winner's curse' on the uninformed investors because they will receive all the shares they bid for in the unattractive offerings, while in attractive offerings, their demand is partly expelled by the informed investors. Thus, the return the uniformed investors earn conditional on receiving an allocation is below the simple average initial return. In an extreme case, the uninformed are completely rationed in underpriced IPOs and receive 100 percent allocations in overpriced IPOs, which results in negative average returns (Ljungqvist, 2007). One possible solution for this problem is to decrease the information asymmetry between informed and uninformed investors. This can be done by using a more prestigious underwriter. Carter, Dark and Singh (1998) study the relationship between underpricing and underwriter rank. They find that, out of three methods to determine underwriter prestige (Carter-Manaster, Johnson-Miller & Megginson-Weiss), the Carter-Manaster method to be the best. This method works in the following way: first, the tombstone announcement is examined and an integer rank is assigned to each underwriter in the announcement based on its position. The most prestigious underwriters get a rank of nine, the next prestigious underwriters eight, etc. Next, this is repeated for every announcement, constantly updating the rank. In the end, this results in a ranking scale from zero, which means least prestigious, to nine, translating into most prestigious (Carter & Manaster, 1990). Carter, Dark and Singh (1998) also find that underwriter prestige is significantly related to long-run performance, namely that the market adjusted returns in the long-run are higher for IPOs which are underwritten by more prestigious underwriters (Carter, Dark, & Singh, 1998).

More than a decade earlier, Beatty and Ritter (1986), also look at underwriter reputation and IPO underpricing. They take the theory of the 'winner's curse' and argue that investment banks have an incentive, as repeat players, to ensure that new issues have enough underpricing or they would lose future underwriting commissions. The implication of this is that underwriters thus force firms or issues into underpricing. However, too much underpricing will make them lose market share (Ljungqvist, 2007). Their first proposition states that the expected underpricing is greater if the ex-ante uncertainty about the issue is greater. Their second proposition is that underwriters whose offerings have average initial returns comparable with their uncertainty lose subsequent market share. They prove these propositions to be right (Beatty & Ritter, 1986). Based on their results, my second hypothesis is:
H2: More underpricing should lead to less market share for underwriters in a next period.

Nanda and Yun (1997) find that overpricing leads to a decrease in the stock value of the lead underwriter. Moderate levels of underpricing, up to 10%, is associated with an increase in the stock value of the lead underwriter. This could indicate that underwriters can extract quid pro quo benefits from allocating moderately underpriced shares to investors (Ljungqvist, 2007). Dunbar (2000) finds similar results. His evidence shows that issuers appear to be avoiding banks that left too much money on the table in the past. Furthermore, his results suggest that market share of investment banks is improved when neither issuers nor investors, are harmed by the pricing of past deals (Dunbar, 2000). However, underwriters would try to keep the IPO underpricing as small as possible since the underwriters fee is proportionally related to the proceeds from the IPO, one could argue (Ljungqvist, 2007). The fact that issues are still systematically underpriced however, means that there must be some relationship between the underwriter and the investors, who would favour the stock to be as cheap as possible. And indeed, Binay, Gatchev and Pirinsky (2009), find that there is a long-term relationship between underwriters and investors. They find that underwriters favour institutions with which they have a historical bond, that means, they have worked together in the past. The results also show that regular investors benefit more than casual investors trough greater participation in underpriced offerings. This effect is larger in IPOs with stronger demand, IPOs of less liquid firms, and deals underwriter by less prestigious underwriters (Binay, Gatchev, & Pirinksy, 2007). This last result would mean that the long-term relationship between investors and underwriters disappears or weakens if underwriters are more prestigious, thus underwriter rank matters.

It is important for an underwriter to maintain a long-term relationship with investors. This can be done through allowing a certain amount of underpricing, thereby giving the investors a chance to earn a positive return on IPO investments. It is proven that individual investors tend to bid in the future if the returns they received in the past were higher. The opposite is also true, they tend to stop bidding when past returns were poor. The results are different for institutional investors, where there is not a big influence of past return on their investment decisions (Chiang, Hirshleifer, Qian, & Sherman, 2011).

Fernando, Gatchev and Spindt (2005), look at a model which explains how issuers choose underwriters. It appears from their study that it is a mutual choice. Underwriters look at the issuer's quality and issuers look at the underwriter's abilities (Fernando, Gatchev, & Spindt, 2005). Benveniste and Spindt (1989) show that investors with positive information about the stock need to be compensated for truthful disclosure of their private information. As a cost of this, underpricing naturally arises. They also show that underwriters can use leverage of expected future profits to lower the amount of underpricing and thus increase the efficiency of the capital allocation process (Benveniste & Spindt, 1989). In a study done by Krigman, Shaw and Womack (2001), it is discovered that firms do not switch to a different underwriter for the SEO based on the actions surrounding the IPO. Rather, they switch because they can 'upgrade' to an underwriter with a higher reputation. This would mean that there should be no influence of IPO underpricing on the switch to a different underwriter for an SEO, when controlling for underwriter prestige (Krigman, Shaw, & Womack, 2001). Therefore, my third hypothesis is:

H3: There is no relationship between IPO underpricing and the choice of underwriter for a Follow-on when controlling for underwriter prestige.

2.2.4 After-market price stabilization

Another aspect of the role of underwriters is after-market price stabilization. This is done to reduce or prevent price drops in the after-market for a couple of days or weeks. According to Ruud (1993) IPOs are not deliberately underpriced, because stabilization prevents the price to drop. Prices are allowed to go up, but the stabilization practices of the underwriter prevent price drops, which gives rise to underpricing. This leads to a positively skewed distribution of returns. She finds that when the underwriter gradually reduces his support, the positive skewness of initial returns eases out, so the initial returns become more normal distributed because the lower bound is taken away (Ruud, 1993). But why do underwriters participate in price stabilization? It could be a bonding mechanism between investors and underwriters. A commitment to price stabilization bonds the underwriter against overstating investor indications of interest before determining the offer price for a new issue. Because the option to sell at the syndicate's stabilizing bid is valuable to investors, it can also complement an implicit promise of an allocation of underpriced shares as compensation for strong indications of interest (Benveniste, Busaba, & Wilhelm Jr, 1996). It could also be a way of ensuring the success of the IPO. Some investors make non-binding interest indications. If they expect the price of the IPO share to be higher than the offer price in the aftermarket, they might renege and decline to buy shares in the IPO but rather and instead buy the shares in the after-market. By price stabilization, underwriters prevent this scenario, making it more likely to have success in the IPO (Schultz & Zaman, 1994). One of the ways an underwriter can influence the price in the after-market is by exercising an overallotment option. This option means that the underwriter has the right to sell 115% of the shares. If the IPO is 'hot' the underwriter shorts 15% of the shares, covering this position by exercising the allotment option. If the IPO is performing poorly, the underwriter covers the short position by purchasing the shares in the after-market, thereby reducing the number of shares in public hands (Schultz & Zaman, 1994). Ellis,

Michaely and O'Hara (2000) show that underwriters buy more shares back for 'cold' offerings (offerings that opened below their offer prices and stayed below in the first 20 trading days) compared to 'hot' offerings (those that opened above the offer price and stayed above during the next 20 days) (Ljungqvist, 2007).

In a study done in 2006, Lewellen finds that stabilization is substantial, leading to rigid stock prices at and below the offer price. She also finds that stocks with larger information asymmetries are not stabilized more strongly, but larger underwriters stabilize more (Lewellen, 2006). Fishe (2002) argues that underwriters use stabilization to increase profits. He states that the offer price needs to be lowered to respond to stock flippers (investors that subscribe to the issue but sell immediately after the issuing, thereby depressing the aftermarket). In the model of Fishe, underwriters stabilize the aftermarket so that they can increase their profits and penalize stock flippers (Fishe, 2002). Asquith, Jones and Kieschnick (1998) examine whether the cross-sectional distribution of early IPO returns represents a mixture of price-stabilized and underpriced issues. They find that it is a combination of both, rather than just a single distribution (Asquith, Jones, & Kieschnick, 1998).

According to Wilhelm Jr (1999), there are three kinds of stabilization. First there are the stabilizing bids. This approach to price stabilization is reactionary to selling pressure created by the immediate resale of shares purchased in the offering. Secondly, there are penalty bids. These bids are created to prevent selling pressure by encouraging syndicate members to discourage investors receiving initial allocations from immediately flipping their shares in the secondary market. The third kind is syndicate short positions. With this, a syndicate manager can induce buying power to offset the selling pressure by overselling or by taking a short position during the offerings' allocation (Wilhelm Jr, 1999).

Another part of the IPO problems is IPO flipping, which I briefly touched upon already, which is the sale of shares acquired in the IPO on short-term (Bayley, Lee, & Walter, 2006). Underwriters usually try to prevent flipping by stabilization mechanisms, as described earlier (Fishe, 2002). Aggarwal (2003) finds that IPO markets that are hot, have more flipping activity than cold markets, thus that there is a positive association between flipping and underpricing. Underpricing plays a role for providing liquidity in the secondary market. Issuers then expect underwriters to encourage some flipping activity to help to develop a liquid secondary market for the IPO. Flipping is determined endogenously (Boehmer & Fishe, 2000).

2.3 'Hot IPO markets' and IPO cyclicality

There seems to be such a thing as 'hot IPO markets'. Ibbotson and Jaffe (1975) and Ibbotson, Sindelar and Ritter (1988, 1994) show that the number of new offerings exhibits cycles. A 'hot' IPO market can be described as a period in which the number of issues is unusually high, where underpricing is more severe

than usual, offerings are frequently oversubscribed and (sometimes) concentration in certain sectors or industries. 'Cold' IPO markets, on the other hand, have a much lower volume of offerings, less underpricing, and the oversubscription of offerings is less frequent (Helwege & Liang, 2004). This thesis looks only at 'hot' IPO markets, but in two dimensions. First the number of offerings, but also at higher underpricing than usual, where usual is defined as average. Another indicator of 'hot' IPO markets is the proceeds from the offering. The IPO proceeds are much higher in 'hot' markets when compared to 'cold' markets. This phenomenon could indicate that the cost of capital is lower in 'hot' IPO markets compared to 'cold' markets, so that is less expensive to obtain capital in 'hot' markets (Alti, 2006). Another explanation of this could be that IPO volume is affected by market conditions. If markets are performing well, issuers want to issue, but if markets are not performing well, issuers might wait till the market is doing well again. This time varying market conditions could thus help to explain IPO cyclicality (Pástor & Veronesi, 2005). Yet another explanation could be adverse selection. An exogenous positive shock to the economy gives bad firms an incentive to pool and enter the market, this increase in offerings leads to IPO waves (Yung, Çolak, & Wang, 2008). Market conditions thus matter for the occurrence of IPO waves. But do firms have a role in this? It was already shown that in markets with a lower cost of capital, issuers are more willing to issue. But the change in a the capital demand of a firm matters as well. Lowry (2003) finds that this change explains, together with changes in the level of investor optimism, a substantial part of the variation of IPO volume (Lowry, 2003). There must be a different reason for firms to go public than just funding needs. It is shown that firms do not have urgent funding needs at the time of going public. This would indicate that there is some form of market timing. Although the study that showed this was done on Italian IPOs it is shown to be at least representative for the European market (Pagano, Panetta, & Zingales, 1998). Actually, market timing appears to play the biggest role (Baker & Wurgler, 2002). A driver of IPO cyclicality could be information spillovers. According to Lowry and Schwert (2002), information learned in the registration period that is not fully incorporated in the offer price, drives the positive relationship between underpricing and subsequent IPO volume. During the marketing period of the IPO, issuers and underwriters collect information from informed investors about the valuation of the firm. This value is used as a underlying basis for the determination of the offer price, but it can also be used by private firms who consider issuing in the near future. More of this positive information leads to higher underpricing and to higher IPO volume after that (Lowry & Schwert, 2002). But what determines the start of a 'hot' period? Well, a 'hot' market starts when common factors gain relative importance and become important determinants of the value of companies. Information spillovers from pioneers' IPOs help to reduce the uncertainty about these common valuation factors and make it less costly for following issues to go public (Alti, 2005). The fourth and last hypothesis of this thesis looks at IPO waves and their link to the rehiring decision and is:

H4: There are IPO waves in the period 2000-2018.

CHAPTER 3 Data and methodology

3.1 Data

3.1.1 Data sources

The main data for the thesis comes from Thomson One. This database provides detailed information on deals, and IPOs in particular. The sample period runs from 01/01/2000 to 12/31/2018. This gives me eighteen years of information, which should be enough to identify IPOs as well as Follow-ons in the sample. The sample will consist of US IPOs. An IPO is identified in two ways. First, there is the variable Issue Type, indicating either an IPO or a Follow-on. Second, there is a variable called IPO flag, which indicates if an offering is an IPO by the letter Y or N, where Y indicates that an issue is indeed an IPO. If these two variables do not both indicate if an issue is an IPO or not, the issue will be removed to avoid noisy data. The database also provides some other useful variables, such as the use of proceeds and the offer price as well as the closing stock price at the first trading day, which can be used to compute the underpricing. All other share price information will be obtained from CRSP. The data will be matched based on CUSIP codes and GVKEY codes. It is common in IPO research to remove IPOs of American Depository Receipts (ADRs), non-ordinary shares, Real Estate Investment Trusts (REITs), closed-end fund shares and unit offerings. These are identified by share codes from CRSP. Also, IPOs with an offer price lower than $5 are removed (Chemmanur & Krishnan, 2012). Finance and utility firms will be dropped. This is because these companies are heavily regulated especially when it comes to equity (Kennedy, Sivakumar, & Vetzal, 2006), thereby possibly biasing the results from empirical research. This will be done by dropping all firms which have a primary SIC-code of 6000-6999 for finance firms and 4900-4999 for utility firms.

The initial dataset as obtained from Thomson One, contains 30,712 issues. To make this a dataset ready for analysis, some changes have been made. First, all companies that have a missing CUSIP-number are deleted. This is necessary to make a merge with data from other data sources possible. Next, all IPOs that are classified as IPO but are not, are excluded. An IPO can be misclassified because Thomson One uses two different measures to classify an IPO. The first one, IPO_flag, classifies an IPO as one if it is the first listing at a specific market. The second one, OriginalIPO_flag, classifies an IPO as one if it is the first listing at any market. The second method is used, this leads to the dropping of another 147 IPOs. Next, all securities issued at non-US markets are excluded. Lastly, all data with a missing offer price, number of shares offered, and proceeds are excluded. A dataset with 12,199 issues is left. In the appendix, a list with all used variables can be found. The number of companies is 5,747. This means that on average, a company does 2.12 issues, which relates to one IPO and one secondary offering. This does not necessarily mean that every firm did an IPO and a secondary offering. It could also be that this includes a third issue, or more than three issues for a firm.

The obtained dataset contains all the names of the managers and their roles in the process, all in one observation. To make it possible to work with this data, all managers and their roles are used as different observations, this leads to an increase of the number of observations to 78,135.

The next step is to merge the data with CRSP data. CRSP data is used to exclude ADRs, non-ordinary shares, REITs, closed-end fund shares and unit offerings. These issues are identified using the variable 'share code' from CRSP. All issues with a first digit in the code other than 1 are deleted. Doing this, the dataset loses many observations, from 78,135 to 38,364. This means that there are 3,605 firms left in the sample, responsible for 7,558 issues. This corresponds to 2.10 issues per firm which is about the same as the number in the sample before all non-ordinary issues were deleted.

After merging with a dataset containing the founding dates of the companies, which is necessary to calculate the age of companies, missing values for age are deleted. This leads to a dataset with 30,561 observations, consisting of 2,818 companies doing 5,975 issues. On average, this means that companies do 2.12 issues, again relating to, on average, one IPO and one Follow-on offering. A further look into the data shows that there are 9,243 IPOs and 21,318 follow-on offerings. This is caused by the fact that there are companies in the dataset who have done an IPO before the start of the sample period but have had one or more follow-on offerings during the sample period or had an IPO or Follow-on with an offer price lower than 5 dollars. These companies will not be deleted from the dataset since it can be very valuable to see how underpricing develops during the sample period.

Lastly, some data from Compustat is required, consisting of data about the fundamentals of the company. After merging with the data coming from Compustat, all non-matched observations are dropped. This means the dataset loses 6,663 observations, leaving 29,126. After dropping all issues from finance and utility firms, the size of the dataset decreases with 11,623 observations. Some other missing data is deleted, leading to another drop of 640 observations. This means that the final dataset consists of 16,863 observations. There are 1,482 companies in the issue, together doing 3,321 issues. On average, this is 2.24 issue per firm.

3.1.2 Variables creation

Some variables need to be constructed in order to enable correct research. First, the variable age is constructed, using the founding date and the year of the issue as inputs. This means that a firm who issues in 2006 and was founded in 1971, has an age of 35 years. This variable age will be used as a control variable, as explained in the methodology section. Next, market share per issuer is calculated. To construct this variable, first the total amount of proceeds needs to be calculated. This is done by adding up all proceeds

as given by the variable ProceedsAmtsumofallMkt (see the appendix for an explanation of all variables). However, this poses a potential problem as this would also add up duplicates. Simply removing duplicates is not possible since valuable data will be lost. So, in the calculation of the total proceeds there are only unique values summed up. If there are multiple managers on an issue, the proceeds are averaged over all managers. Next logarithms of some control variables are created, as described in section 3.1.3. Also, the number of managers per issue is calculated. Finally, the variable rehire, which indicates if a manager is rehired by a company for a next issue is constructed.

3.1.3 Descriptive statistics

In the table below, the descriptive statistics are presented.

Table 1 Descriptive statistics

	N	*Mean*	*St. Dev.*	*Min*	*Median*	*Max*
Offerprice	16,863	26.85	25.10	5.00	20.00	320.00
Proceeds	16,863	334.99	1,078.48	0.73	144.45	16,006.88
Shares offered (million)	16,863	13.00	31.00	0.018481	7.00	480.00
Age	16,863	21.69	23.16	0.00	13.00	115.00
Number managers	16,863	8.38	5.98	1.00	7.00	39.00
Market share	16,683	0.02	0.03	0.00	0.01	0.22
Debt before offering (mil)	16,672	974.88	2573.41	0.00	117.59	73,060.00
Assets before offering (mil)	16,547	2,646.21	9,169.84	0.90	446.20	190,000.00
EBITDA before offering (mil)	12,611	206.50	1,401.72	-26,000.00	50.70	24,659.00
EBIT before offering	13,072	57.03	14,22.33	-30,000.00	22.50	12,692.00
Rehire	16,863	0.29	0.46	0.00	0.00	1.00
Number of Proceeds	16,863	3.51	1.87	1.00	3.00	11.00
Overallotment	16,863	0.10	0.0	-0.00	0.15	0.15
Return on S&P 500 Index	16,863	0.00	0.01	-0.05	0.00	0.07

As one can observe, the average offer price in the period 2000-2018 is 26.85 dollars. The minimum is 5 dollars, that is because all offers with an offer price lower than five dollars are removed from the sample. Maximum offer price is 320 dollars. The average proceeds in the offerings is 335 million dollars. Minimum proceeds is 730,000 dollars, while the maximum is 16 billion dollars. The number of shares offered ranges from 18,481 thousand to 480 million, with a mean (median) of 13 (7) million shares. The average firm in the sample is almost 22 years old, while the youngest is 0 years old. This means the company issues in the same year as the company is founded. The oldest company is 115 years old and is established in 1901. On average, firms have a bit more than 8 managers in the syndicate per issue. The minimum is 1 manager, while the maximum is 39 managers. Market share per manager is low, with the mean and the median being 2% and 1% respectively. The minimum is lower than 1 percent, while the maximum is 22 percent. On

average, firms have 975 million in debt before the offering. The average firm has 2.6 billion assets before the offering, with a minimum of 900,000 and a maximum of 190 billion. EBITDA before the offering is on average 207 million dollars, while EBIT was 57 million dollars. Managers get rehired in 29 percent of the cases, as shown by the variable rehire. The average (median) number of uses of the proceeds from the issue is 3.51 (3.00). On average, there is 10 percent shares oversold as indicated by the variable overallotment. The average return on the S&P 500 index is close to zero percent. Some variables, Debt, Assets, EBITDA and EBIT, do not have 16,863 observations, this is due to missing data. Still, there are more than twelve thousand observations in for the variable with the most missing data, EBITDA.

Comparing mean and median, one can see that the mean is almost in every variable higher than the median, meaning that the data is skewed to the left. After a visual check of the boxplots of these variables, it appears that some variables have some big outliers. Therefore, I winsorized these variables on the 1 and 99 and 5 and 95 percent level and presented the outcomes in table 2.

Table 2 Descriptive statistics winsorized variables on the 1 and 99, and 5 and 95 percent level

	Mean	*St. Dev.*	*Min*	*Median*	*Max*
Offerprice (99)	26.28	21.21	5.60	20.00	130.90
Offerprice (95)	24.81	15.87	7.00	20.00	67.00
Proceeds (99)	271.87	342.12	20.25	144.45	2,200.00
Proceeds (95)	246.82	243.62	39.38	144.45	924.00
Shares offered (99)	11.00	12.00	1.40	7.00	85.00
Shares offered (95)	10.00	8.00	2.40	7.00	32.00
Debt (99)	900.36	1,938.44	0.00	117.59	11,959.00
Debt (95)	724.17	1,205.69	0.00	117.59	4,424.00
Assets (99)	2,253.36	4,827.97	13.60	446.20	30,734.00
Assets (95)	1,779.38	2,812.67	34.30	446.20	10,485.00
EBITDA (99)	261.46	727.91	-985.90	50.70	4,573.40
EBITDA (95)	200.33	373.37	-142.20	50.70	1,376.20
EBIT (99)	123.31	508.08	-1,479.10	22.50	2,909.00
EBIT (95)	100.29	242.65	-204.90	22.50	878.00

As one can see, the data gets less skewed when it is winsorized. Still, most variables are skewed to the left, meaning that there are still large outliers on the positive side. I have chosen to run the regressions with the original values, but from some variables such as assets and debt, are the logs (log(1+variable)) taken. The descriptive statistics are presented in the table below.

Table 3 Descriptive statistics for log-transformed variables

	N	*Mean*	*St. Dev.*	*Min*	*Median*	*Max*
Log(assets)	16,547	6.24	1.80	0.64	6.10	12.15
Log(debt)	16,672	4.11	3.06	0.00	4.78	11.20
Log(EBITDA)	8,744	4.87	1.69	-2.30	4.92	10.11
Log(EBIT)	8,211	4.44	1.68	-2.30	4.39	9.45

Doing this, the number of observations go down, to a minimum of 8,211 observations for the logarithm of EBIT. The drop in observations is caused by values smaller than zero. When transforming the data to a logarithmic scale, these values are replaced with missing values. Comparing means and medians, it is clear that the data is less skewed.

3.2 Methodology

The main goal of this thesis is to find a long-term relationship between issuers and underwriters, if there is any. In order to answer the research question with the collected data a certain number of tests will be executed. First, I want to examine the level of underpricing in my sample. Therefore, I will use the following formula:

$$U = \frac{P_t - O_t}{O_t} \quad (1)$$

In this formula, U stands for underpricing, P_t for the price of the security at the end of the first trading day and O_t for the offer price. By applying this formula for all separated years, a first insight can be obtained in the possibility of IPO cyclicality. Underpricing will be calculated for the entire sample, but also for subsamples consisting of only IPOs, or only Follow-ons. To gain some insight in the drivers of this underpricing, I will run a regression where the dependent variable is underpricing and the independent variables are several explanatory variables, coming from previous research on this matter. The control variables will control for ex ante firm uncertainty and market performance. The uncertainty will be controlled for by firm age (Ritter, 1991) & (Barry, Muscarella & Vetsuypens, 1991), the amount of debt in the firm before the IPO (James & Wier, 1990), underwriter prestige (Carter & Manaster, 1990), firm size proxied for by assets (Barry & Brown, 1984), the EBITDA and EBIT in the year before the offering and the number of uses for the proceeds as mentioned in the prospectus. The market conditions will be controlled for by the S&P 500 return at the day of the offer. I will run three regressions, one for the entire sample, one for the subsample of IPOs and one for the subsample of Follow-ons. Differences will be tested for significance.

The main analysis will start by performing a probit regression, where the dependent variable is an indicator showing whether or not an issuer chose the same underwriter for the Follow-on offering and for

the IPO. The main explanatory variable will be the amount of underpricing at the offering. Together with some control variables that should help explain the amount of underpricing, this regression should give insight in the chance of choosing the same underwriter for a given amount of underpricing. Possible explanatory variables are the returns in the four weeks after the trading starts, split up in two variables, one for the first two weeks and one for the next two weeks (Su & Fleisher, 1999). The variables I use, however, are underpricing, market share, overallotment, which is an indicator variable that indicates if an underwriter has performed any stabilization practices after the previous offering, and the two digit SIC codes to see if there are differences between sectors.

The relationship between underwriter and issuer will also be examined following the methodology of Beatty and Ritter (1986). They model uncertainty in two ways: first the log of one plus the number of listed uses for the proceeds in the prospectus and second the inverse of the gross proceeds. Their second test looks at the consequences of underpricing for underwriters. For that, they take the initial return (which is simply the underpricing) and use that as an explanatory variable in a regression of the market share of the underwriter. Market share is counted here as the fraction of IPOs that the manager managed or co-managed. I will run a regression of underwriter rank on underpricing, complemented with some control variables. However, there is no good measure of underwriter ranking. Jay Ritter has a ranking published on its website, but that ranking is only fully updated to 2012. Therefore, I chose to use market share as a measure of underwriter reputation.

A following regression looks at underwriter market share. Market share is the dependent variable, where underpricing is the main explanatory variable. Also, market share from the previous year is taken as a control variable. A second and third lag will be used, to see for a longer-term effect. This will also be done for a split sample of offerings below and above 10 million proceeds. This is done to isolate any effect of the IPO market. It could be that some underwriters are doing only smaller offerings. If the IPO market in a certain year contains mainly large offerings, the market share of these underwriters would automatically get less. However, it appears that the sample does not have many small offerings so these results will be left out.

To test for IPO cyclicality, a visual check will be performed. The number of offerings and the amount of underpricing will be plotted in a figure. These figures should already show possible cycles. The amount of underpricing in these wave years will be examined. Next, underpricing will be tested for significance difference from the average value. Lastly, I link the IPO waves to the probit regression by adding an indicator variable for the years in which there is a possible IPO wave.

All regressions are ran with robust standard errors, accounting for possible heteroskedasticity.

CHAPTER 4 Results

4.1 Underpricing

First, I will look at the amount of underpricing in this sample. Table 4 shows the first results. Underpricing is calculated using formula 1 as described in section 3.2. The results are presented for the entire sample, but also for a subsample of underpricing for all IPOs and all Follow-ons. The differences are tested for significance. Also, underpricing is presented per year.

*Table 4 Total underpricing. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total underpricing	*Subsample IPOs*	*Subsample Follow-ons*	*IPO – Follow-on*
Entire period	0.0647396***	0.163601***	0.0299669***	0.1336342***
2000	0.0584597***	0.2196531***	0.0193825***	0.2002706***
2001	0.0802812***	0.1899804***	0.0288763***	0.1611041***
2002	0.0533122***	0.1013883***	0.0306332***	0.0707552***
2003	0.0731541***	0.158358***	0.0450836***	0.1132744***
2004	0.0663707***	0.1307561***	0.0287013***	0.1020548***
2005	0.0559471***	0.1038466***	0.0277397***	0.0761069***
2006	0.0750732***	0.1406218***	0.0224918***	0.11813***
2007	0.068103***	0.1403775***	0.024841***	0.1155365***
2008	0.0381598***	0.1275055***	0.0254672***	0.1020383***
2009	0.0690004***	0.3169688***	0.0320515***	0.2849173***
2010	0.0376259***	0.0806014***	0.0260461***	0.0545553***
2011	0.0446515***	0.090892***	0.0338999***	0.056992***
2012	0.0819306***	0.1976681***	0.0307907***	0.1668773***
2013	0.082636***	0.2160404***	0.027994***	0.1880464***
2014	0.0805283***	0.1826492***	0.0247732***	0.1578759***
2015	0.0744244***	0.2420547***	0.0315358***	0.210519***
2016	0.0277621***	-0.046875	0.0292202***	-0.0760952***
2017	0.0375791***	0.3784066***	0.0339752***	0.3444314***
2018	0.0394341***	n/a	0.0394341***	n/a

The total average underpricing in the entire sample is 6.47% and significant at the 1% level. When the entire sample is split up in years, underpricing remains significant at the 1% level and positive. Underpricing is at the lowest level in 2016, namely 2.78% and at its highest in 2013 with 8.26%. When looking at the subsample of only IPOs a larger range is found. Overall, the average underpricing on IPOs is 16.36%. This number deviates per year. The highest amount of underpricing can be found in 2017, when underpricing was 37.84%. One year before that, in 2016, underpricing was negative, -4.69%. This number however is not statistically significant from zero. The sample contains just 1 IPO from 2018, however, data

is missing on the closing stock price on the day of the offering, so it is not taken into this analysis. Also, some other years have also a very low number of IPOs. See table B.1 in appendix B for an overview of the number of IPOs and Follow-ons.

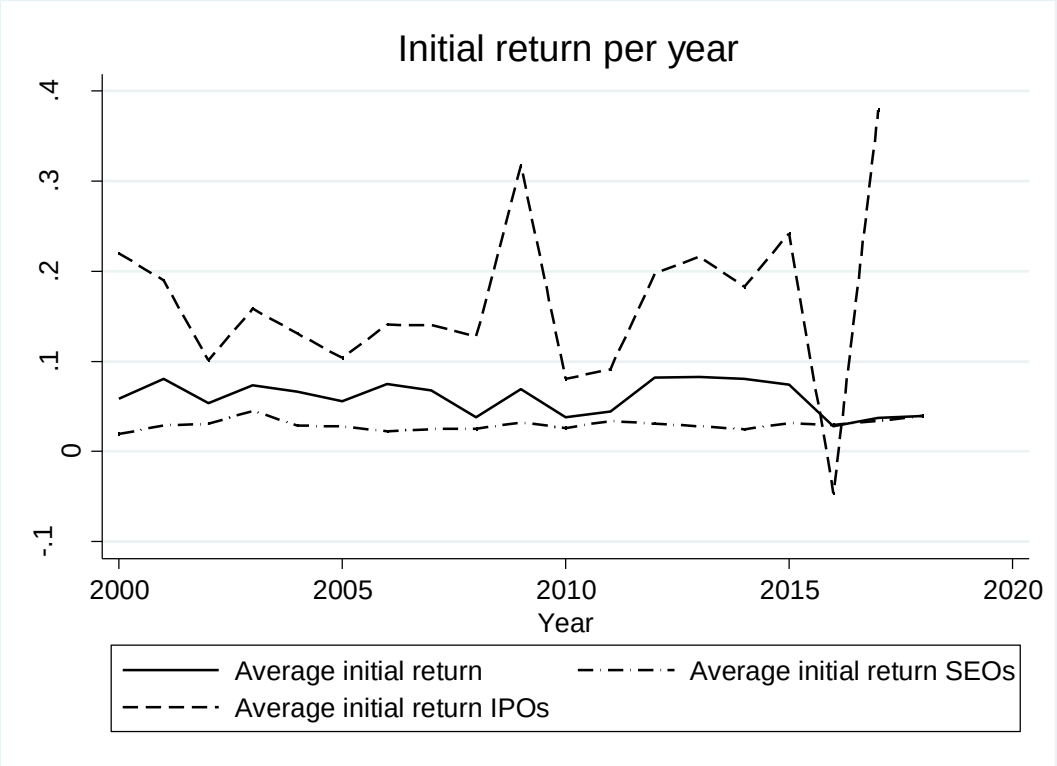

Figure 1 Average underpricing per year, for the entire sample and the subsample for IPOs and Follow-ons

In figure 1, the average underpricing per year is plotted. There are three different lines plotted, one for the overall average underpricing, one for the subsample of IPOs and one for the subsample of Follow-ons. It becomes clear that the average underpricing per year does not change much for Follow-ons but it is much more volatile for IPOs. The low volatility of underpricing in Follow-ons dampens the effect of the volatility of IPOs on the overall volatility.

It is clear that there is significant underpricing in the sample period. But what are the drivers of this phenomenon? To answer that question, I regressed the underpricing on several control variables, as described in the methodology. Table 5 shows the results.

*Table 5 Regression of underpricing on several control variables. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Underpricing overall	*Underpricing only IPO*	*Underpricing only Follow-ons*
Age	-0.0001474***	-0.0003276**	0.0000883***
Log(assets)	-0.012989***	-0.0190715	-0.0011692
Log(EBITDA)	0.0008801	-0.0056183	-0.0054581**
Log(EBIT)	-0.0044995	0.0015972	-0.0011569

Log(debt)	-0.0002152	-0.0089397**	-0.0000476
Marketshare underwriters	0.0117898	0.1251019	-0.05541***
Number of Proceeds	0.0041998***	-0.0102597***	-0.0002392
S&P 500 return	-0.248082**	-1.645574***	0.014815
Constant	0.1433052***	0.3810182**	0.0657166***
N	7,615	1,446	6,169
Adjusted R^2	0.0684	0.0863	0.0635
F-statistic	43.55	16.71	48.15

In the table above, three regressions are presented. The first one contains the entire sample. The coefficient of age is negative and significant at the 1% level. This means that older firms tend to have less underpricing on their offerings. Specifically, a firm that ages 1 year, has 0.01 percentage point less underpricing. The size of the firm also has a negative impact on underpricing as can be seen by the coefficient of log(assets). The coefficient is also significant on the 1% level. This coefficient should be interpreted in the way that if assets changes with 1 percent, underpricing decreases with -0.00012989 units of underpricing, meaning underpricing would decrease with 0.013 percentage point. A rise in assets of 100% would mean a decrease in underpricing of 1.3 percentage point. The same interpretation goes for EBITDA, EBIT and debt. If EBITDA rises with 1%, underpricing increases with 0.001 percentage point. An increase of 1% in EBIT would mean a decrease of 0.004 percentage point in underpricing. If debt increases with 1%, underpricing would be 0.002 percentage point lower. The coefficients of log(EBITDA), log(EBIT) and log(debt) are not statistically significant. Also, the control variable market share is included. This measures the effect of the market share an underwriter has in a certain year on the underpricing for a firm in that year. It shows that having an underwriter with a higher market share leads to more underpricing. This is not an expected result, for it shows that having a higher ranked underwriter increases underpricing, rather than decreasing it. The coefficient, however, is not statistically significant. The number of uses of the proceeds as described in the prospectus has a positive, significant impact on underpricing. The S&P 500 return on the day of the offering shows a negative effect on underpricing. This coefficient is statistically significant at the 5% level. The regression was based on 7,615 observations and has an adjusted R-squared of 0.0684 meaning that 6.84% of the variation in underpricing is explained by these control variables. The adjusted R-squared is presented because it better predicts the explanatory effect of the model. The normal R-squared will always increase when more variables are added to the regression. The adjusted R-squared only increases if the extra variables have additional explanatory power. Lastly, the F-statistic is 43.55. The F-statistic shows the probability that all coefficients are equal to zero. An F-statistic of 43.55 is high enough to state that this is not the case. All the effects described above are in the case of keeping all other variables constant.

The regression on the subsample of only IPOs shows some different results. Four variables, age, debt, number of proceeds and the S&P 500 return are statistically significant. This means that the coefficient on

assets has lost its significance. The signs on the coefficients of age, assets, debt, market share and the return of the S&P 500 are the same as in the first regression. The sign of the coefficients of the variables EBITDA, EBIT and number of proceeds are different. Older firms have lower underpricing, all other variables held equal. The coefficient should be interpreted in the way that a firm which ages one year, has 0.0033 percentage point less underpricing. The size of the firm, as measured by the logarithm of assets has a somewhat bigger effect on underpricing compared to the first regression. The coefficient, however, loses significance. The logarithm of EBITDA has a negative effect on underpricing, as opposed to the first regression where it had a positive effect. However, this coefficient is also not statistically significant. The logarithm of EBIT now has a, statistically seen non-significant, positive effect on underpricing. The amount of debt in the year before the offering has a negative effect on underpricing in the IPO subsample. If debt increases with 1%, underpricing decreases with 0.009 percentage point. This result is now significant at the 5% level. This might indicate that the market thinks the issue is more realistic priced, or that the market sees the stock of the firm as more risky, therefore keeping the prices low. The market share of underwriters has a large positive effect; however, this is not statistically significant. It would indicate however, that the reputation of the underwriter, which is proxied for by their market share, is in fact increasing, the underpricing, instead of decreasing as one would expect. It could be that this large effect would be eased out if there were more observations on IPOs. The number of proceeds shows a negative effect on underpricing. This means that the market sees the offer price to be closer to the real value of the stock if there is more described about the uses of the proceeds. This coefficient is statistically significant at the 1% level. The return of the S&P 500 has a negative effect on underpricing, meaning that the market is valuing the stock to be closer to the offer price if the S&P 500 return is higher. This coefficient is also significant at the 1% level. The number of observations used in this regression is 1,446 and this set of control variables explains 8.63 percent of the variation in underpricing. The F-statistic is 16.71.

The third regression is only run on the subsample of Follow-ons. It appears that age of the firm is less important. The effect of a firm that ages 1 year is 0.00009 percentage point, all else equal. This might be because the firm is more known to the market, since it is already a public company. Measures of uncertainty like age are of less importance. The coefficient is statistically significant at the 1% level. The size of the firm again has a negative impact. Larger firms are less underpriced. This effect is not statistically significant. The logarithm of EBITDA has, like in the subsample of IPOs, a negative impact on underpricing, which is significant at the 5% level. A 1% increase in EBIT leads to a decrease of 0.001 percentage point in underpricing. This is not significant. The amount of debt in the year before the offering now has a statistically non-significant negative effect on underpricing. Market share of the underwriters has a negative, statistically significant, effect on underpricing. Here it goes that having an underwriter with more market share, i.e. a higher ranked underwriter, helps to decrease the amount of underpricing. The number of uses for the proceeds have a negative impact on underpricing, which is not significant. The return of the S&P 500 now has a positive impact on underpricing. This effect is not statistically significant. The

set of control variables used in this regression is also not enough to explain much of the variation in underpricing, the adjusted R-squared of this regression is 0.0635. The F-statistic is 48.15.

The results presented above suggest that issues in the US in the period 2000-2018 have significant underpricing. When looking at the results for the entire sample, the average underpricing is 6.47 percent. When the sample is split up in two subsamples, namely a sample with only IPOs and a sample with only Follow-on offerings, there is still significant underpricing. The average underpricing for IPOs is, with 16.36 percent, 13.36 percentage point higher than the average underpricing for Follow-ons, which is 3.00%. When looking at figure 1, a very volatile pattern can be seen for underpricing per year for IPOs, while average underpricing for Follow-ons shows a less volatile pattern, even close to being constant over time. The results presented in table 4 confirm this. Based on these results, I can confirm hypothesis 1 that there is significant underpricing in the period 2000-2018 for US issues, both for IPOs and Follow-on offerings.

4.2 Underwriter market share

Not only the issuers will be impacted by underpricing, but also underwriters. It could be possible that issuers choose a different underwriter for the next issue if the amount of underpricing was high. Although high is a subjective term, it should be read in a way that companies want capital, otherwise they don't issue, and they will not be happy with too much money left on the table. If this is the case, they will possibly choose a different underwriter. Underwriter market share is a measure for this. It is also used as a proxy for underwriter ranking.

Average market share is 2.00 percent, as can be seen in table 1 and 6.

Table 6 Market share of underwriters per year

	n	*Mean*	*Min*	*Median*	*Max*
Entire sample	16,863	0.02	0.00	0.01	0.22
2000	123	0.02	0.00	0.01	0.09
2001	916	0.02	0.00	0.01	0.09
2002	833	0.02	0.00	0.01	0.07
2003	803	0.02	0.00	0.01	0.07
2004	1,146	0.02	0.00	0.01	0.07
2005	874	0.03	0.00	0.02	0.10
2006	839	0.03	0.00	0.02	0.10
2007	900	0.03	0.00	0.02	0.19
2008	414	0.03	0.00	0.01	0.22
2009	746	0.03	0.00	0.01	0.15
2010	797	0.02	0.00	0.01	0.08

2011	741	0.02	0.00	0.01	0.08
2012	884	0.02	0.00	0.01	0.11
2013	1,692	0.02	0.00	0.01	0.11
2014	1,666	0.02	0.00	0.01	0.10
2015	1,510	0.03	0.00	0.02	0.10
2016	835	0.02	0.00	0.01	0.11
2017	669	0.03	0.00	0.02	0.13
2018	475	0.03	0.00	0.01	0.10

As table 6 shows, underwriter market share is stable over the years. The maximum also seems to be correlated with earlier years. These results indicate that market share is not influenced by volatility in underpricing. To look further into this, a regression is done. The dependent variable is market share and the explanatory variable is underpricing. The results are presented in table 7.

*Table 7 Regression of market share on underpricing. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Entire sample	*Only IPOs*	*Only Follow-ons*
Underpricing	-0.0026716*		
Underpricing IPOs		0.0046372***	
Underpricing Follow-ons			-0.0379441***
Constant	0.024669***	0.0224036***	0.0261023***
N	16,383	4,263	12,120
Adjusted R^2	0.0001	0.0019	0.0055
F-statistic	3.09	7.24	56.08

The results in table 7 show that underpricing has certain influence on market share, however, the effect is very small. For the entire sample, underpricing lowers the market share of the underwriters by 0.003 percentage point. This coefficient is significant at the 10% level. The adjusted R-squared of this regression is 0.01% meaning that the variation in market share is almost entirely explained by other factors than underpricing. The F-statistic is 3.09, which relates to a p-value of 0.0789, meaning that the hypothesis that all coefficients are equal to zero, can be rejected at the 10% level.

When only looking at the IPOs, the effect of underpricing in IPOs has a positive effect on the market share of underwriters. This could be due to the fact that there is more uncertainty about the market value of the firm before an IPO meaning that firms are not as dissatisfied as one would expect about underpricing because it is harder to make an estimate of the offer price. Underpricing has a positive effect on market share but this effect is also very small. It is statistically significant at the 1% level. The adjusted R-squared is 0.19%. The F-statistic is 7.24.

When looking at the subsample of Follow-ons, underpricing is found to have a negative impact on market share. The coefficient is significant at the 1% level and is more than ten times the magnitude of the coefficient of underpricing in the entire sample. This indicates that firms do not like underpricing in their secondary offerings. The R-squared of this regression is still very low, just 0.55% of the variation in market share is explained by underpricing in Follow-ons. The F-statistic is 56.08.

However, this regression looks at underpricing and market share in the same year. It would make much more sense if the lag of underpricing is used. Therefore, I ran the regression again, but now with the first, second and third lag of underpricing. The results can be found in table 8.

*Table 8 Market share of underwriters regressed on several lags of underpricing. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	First lag	*Second lag*	*Third lag*	*First and second lag*	*All Lags*
L_underpricing	-0.0033591**			-0.0031399*	-0.0030261*
L2_underpricing		-0.0040141***		-0.0038636**	-0.0038253**
L3_underpricing			-0.0041026***		-0.0034707**
Constant	0.0255327***	0.0261618***	0.0266545***	0.0263074***	0.0269832***
N	15,772	15,357	15,011	14,930	14,196
Adjusted R^2	0.0003	0.0004	0.0004	0.0006	0.0008
F-statistic	4.66	6.67	7.25	5.30	5.13

The results show that the lag of underpricing has a negative effect on market share. Although this effect is statistically significant on the 5% level, it has a very small effect on market share. The adjusted R-squared of the regression shows that just 0.03% of the variation in market share is explained by the first lag of underpricing. When looking at only the second lag of underpricing, the coefficient increases a little. The magnitude of the effect is similar to the effect of the first lag, and the adjusted R-squared rises to 0.0004. The statistical significance is now 1%. The third lag of underpricing also has a negative effect on market share, but again, this effect is very small. It is also statistically significant at the 1% level. The adjusted R-squared of this regression is 0.0004. The third lag of underpricing has thus comparable explanatory power for market share, which even might be a bit larger. The F-statistics of the first three regressions are between 4.66 and 7.25 meaning that all coefficients are statistically different from zero.

When looking at the regression with the first and second lag of underpricing, it can be seen that the first and second lag both have a similar effect on market share. It becomes clear that underpricing has a negative impact on underwriters' market share, but the explanatory power of the lags is not high. The coefficients are statistically significant on the 10% and 5% level, respectively, but the adjusted R-squared of the regression is just 0.06% and the F-statistic is 5.30.

Lastly, I did a regression with all three lags of underpricing. The coefficients of the first and second lag are somewhat smaller compared to the coefficients as in the regression with the two lags. The coefficient of the first lag is significant at the 10% level, the two other coefficients are significant at the 5% level. The R-squared of this regression is 0.0008 meaning that 0.08% of the variation in underpricing is explained by the three lags. The F-statistic is 5.13.

It is likely that market share of underwriters for a big part is influenced by market share in previous years. To see how big that effect would be, I regressed market share on its lags. The results can be found in table 9.

*Table 9 Market share of underwriters regressed on lags of market share and lags of underpricing. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	One lag	*Two lags*	*Three lags*	*Underpricing and one lag*	*Underpricing and two lags*
L_marketshare	0.961794***	0.5178457***	0.419768***	0.9605248***	0.5347373***
L2_marketshare		0.4613718***	0.3501884***		0.4425524***
L3_marketshare			0.2135726***		
L_underpricing				-0.0004906	-0.0002077
L2_underpricing				-0.000646	-0.0007096
L3_underpricing				-0.0000146	-0.0001783
Constant	0.00097***	0.0005456***	0.0004417***	0.0010823***	0.0006501***
N	16,239	15,812	15,461	14,196	14,196
Adjusted R^2	0.9249	0.9399	0.9418	0.9253	0.9389
F-statistic	20282.57	14711.04	10708.53	5064.42	5591.77

As the results in table 9 show, the lags of market share have a strong effect on current market share. The coefficient of the first lag is 0.961794 meaning that for every percentage point higher market share in the previous year, current market share rises with 0.96 percentage point. The coefficient is statistically significant at the 1% level. The adjusted R-squared of this regression is 0.9249 meaning that 92.49% of the variation in market share is explained by the first lag of market share. It becomes clear that the effect of market share is persistent over time when I introduce the second lag in the regression. The coefficient of the first lag decreases to 0.5178457, still statistically significant on the 1% level. The effect of the second lag is 0.4613718. This coefficient is also significant at the 1% level. The adjusted R-squared of this regression increases slightly to 0.9399, meaning that now 94% of the variation in market share is explained by the two lags of market share. Adding the third lag of market share also increases the adjusted R-squared a little. The coefficient on the first lag decreases again, now having an effect of 0.42 percentage point for every percentage point higher market share in the previous year. Market share of two years ago now has a

smaller effect, namely 0.35 percentage point for every percentage point higher market share two years ago. This coefficient is significant on the 1% level. The third lag of market share has an effect of 0.2135726 on market share, statistically significant at the 1% level. The F-statistics of all these regressions is very high, thus the coefficients in all these models are statistically different from zero.

Looking at these results, one might wonder if the effect of underpricing still exists with one or more lags of market share. Therefore, I included all three lags of underpricing together with one lag of market share in the regression. The results are also presented in table 9. The effect of the first lag of market share is similar to the first regression, it is also significant at the 1% level. The three lags of underpricing again have a very small effect on market share, all three lags have a negative effect. None of the lags of underpricing are statistically significant. Comparing the adjusted R-squared of the first regression with this regression shows that adding three lags of underpricing does not increase the explanatory power of the model much. Lastly, I added the second lag of market share. Again, the coefficients of the two lags of market share are similar to the coefficients in the second regression. Still, none of the lags of underpricing is significant.. Now all three lags of underpricing have a negative effect on market share.. The adjusted R-squared of this regression increases to 0.9389.

These regressions show that the lags of market share have a strong effect on market share. The lags of underpricing become not significant when lags of market share are introduced in the regression. In unreported analysis, these regressions were run for the subsamples of IPOs and Follow-ons. For the subsample of IPOs only the first lag of underpricing had a significant positive effect on market share. This effect becomes insignificant when more lags are introduced. For the subsample of Follow-ons, all three lags have a negative impact on market share. This effect stays persistent when more lags are introduced, it also does not change the significance. Considering all these results, it is ambiguous whether to accept or reject the second hypothesis. It appears that underpricing has a negative effect on the market share of an underwriter. However, it should be noted that this effect is very small and that this effect becomes insignificant if the history of market share is taken into account. The signs of the lags of underpricing do stay negative. This has led me to accepting the second hypothesis, because it shows that there is a negative impact of underpricing on market share, although it is not significant. In addition to the hypothesis, which states that underpricing leads to less market share in the next period, it should be noted that underpricing affects market share for at least three periods, Again, this effect is very small and becomes insignificant when lags of market share are added to the regression. These results show however, that underwriters are not punished much for high underpricing. Unfortunately, it is not possible to see how this effect differs between 2, 3 or more issues, because all other issues than IPOs are included in the Follow-on sample. There is no different indicator for, for example, an SEO or TBO.

4.3 Relationship between issuer and underwriter

In this section, I examine the relationship between the issuer and the underwriter. For that, I created the variable rehire, which is an indicator variable indicating if a manager gets rehired in a Follow-on offering. This variable is used as the dependent variable in a probit regression. The main explanatory variable will be underpricing. The results are presented in table 10.

*Table 10 Regression of rehire on underpricing and control variables. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*IPO sample*	*Follow-on sample*	*Total sample + market share*	*Total sample, market share + overallotment*
Underpricing	-2.595845***			-2.554618***	-2.902284***
Underpricing IPO		0.1322456			
Underpricing Follow-on			-1.045834***		
Marketshare				5.093547***	5.105049***
Overallotment					1.547356***
Constant	-0.3945078***	-2.765637***	-0.2062557***	-0.5256376***	-0.666224***
N	16,383	4,263	12,120	16,383	16,383
Pseudo R2	0.0331	0.0008	0.0016	0.0427	0.0471

The coefficient of underpricing on rehire in the first regression is negative, indicating higher underpricing has a negative effect on the chances of being rehired for a manager. The coefficient of -2.595845 should be interpreted as follows. This coefficient can be used to calculate the probability of rehiring. For that, the cumulative distribution function of the standard normal is used. If we would use the average issue, which has an average underpricing of 0.0647396 (see table 4), the predicted probability would look like:

$$Predicted\ probability = F(-0.3945078 - 2.595845 * 0.0647396) = 0.28686667 \quad (2)$$

The outcome of this equation is 0.28686667. This means that the underwriters who did an issue with average underpricing as a result have a change of 29% of being rehired. Note that the probability of rehiring is not linear. When underpricing increases with one unit, this has a certain effect on the probability of rehiring. However, when underpricing increases again with one unit, this has a different effect on the probability of rehiring, as opposed to a normal Ordinary Least Squares (OLS) regression, where the effect is always similar. This explanation can be best described with an example.

$$Predicted\ probability = F(-0.3945078 - 2.595845 * 1) = 0.00139328 \quad (3)$$

$$Predicted\ probability = F(-0.3945078 - 2.595845 * 2) = 1.16 * 10^{-8} \quad (4)$$
$$Predicted\ probability = F(-0.3945078 - 2.595845 * 3) = 1.395 * 10^{-16} \quad (5)$$

As one can see, the probability of rehiring decreases with more underpricing, but not with the same steps. These examples, however, translate to an increase of underpricing with 100 percentage point, but they show how this mechanism works.

The pseudo R-squared that is presented is not the same as the R-squared used in the OLS regressions. Although it serves the same purpose, namely showing the goodness of fit of the model, it is computed in a different way and should be interpreted in a different way. The pseudo R-squared presented here is McFadden's (1973) R-squared. This measure of fit is calculated in the following way:

$$R^2 = 1 - \frac{\ln\left(L(M_{full}\right)}{\ln\left(L(M_{intercept}\right)} \quad (6)$$

Here, M_{full} stands for the model with predictors and $M_{intercept}$ stands for the model with only the intercept. L stands for estimated likelihood (McFadden, 1973). If $L(M_{full})$ is greater than $L(M_{intercept})$, the R^2 will be greater, because the log of this likelihood, which can take any value between 0 and 1, will be smaller then. Thus, a small log ratio of likelihood, indicates that the model with the predictors is a better fit than the model with only the intercept. In this case, the pseudo R-squared is 0.0331 meaning that the full model is slightly better fitting then only the intercept.

Looking at the subsample of only IPOs, do underwriters get rehired when they underpriced in IPOs? The answer is yes, underpricing does have a positive effect on rehiring, but this coefficient is not significant. The pseudo R^2 is 0.0008 meaning that the model with the predictor hardly fits better than the model with only the intercept. The effect of underpricing in the subsample of Follow-ons is negative and statistically significant. It appears that underpricing in a Follow-on offering has much more consequences for an underwriter compared to underpricing in IPOs. The pseudo R-squared of this probit regression is 0.0016 meaning that the subsample of the follow-ons fits slightly better than the subsample of IPOs.

Next, I added market share of underwriters to the regression. Since this is a proxy for underwriter reputation, the expected effect would be positive, because one would expect a higher ranked underwriter to have a higher chance of being rehired. This effect is indeed positive. The coefficient of 5.093547 means that an underwriter with an average market share (0.0245213) who priced an issue with no underpricing would have 34.4% more chance to be rehired. An average underwriter with an offering with average underpricing would have a 28.6% chance of being rehired. The pseudo R-squared of this regression is 0.0427 meaning that the full model with predictors underpricing and market share fits better than a model with only the intercept.

Lastly, I added the variable overallotment to the regression. Overallotment is a proxy for stabilization practices after an offering. Adding this variable does not change much to the coefficients on underpricing and market share. The pseudo R-squared also does not change much, from 0.0414 to 0.0415. The effect of overallotment on the probability of rehiring is relatively small. In the theoretically case that an underwriter has no underpricing and no market share, the average overallotment (0.1499869) would mean that the probability of being rehired is 29 percent. The entire average underwriter, thus with average underpricing, average market share and average overallotment would have a probability of rehiring of 28.2%.

Looking at all these results, one can conclude that underpricing has a negative effect on the probability of rehiring. This shows that issuers penalize underwriters for having too much underpricing in a previous offering. However, this effect is battled by the effect market share of the underwriter has on the probability of rehiring. It seems that the chance to hire a more prestigious underwriter weighs up to the fact that there was underpricing in the previous issue. Lastly, it is shown that stabilization practices have a positive effect on the decision to rehire, although the effect is not large.

It could also be that in some sectors, underwriters are scarce, because specific knowledge is needed to underwrite an offering in that sector, and not many underwriters have that knowledge. Therefore, I ran the regressions of table 10 again, but now with dummies for every two digit SIC code. This SIC code is the main SIC code for a firm, thus the sector the firm operates mainly in.

*Table 11 Partial regression model for the probit regressions with dependent variable rehire and independent variables underpricing, market share, overallotment and sic-dummies. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*Total sample + market share*	*Total sample, market share + overallotment*
Underpricing	-2.489783***	-2.446182***	-2.741749***
Market share		5.481021***	5.491282***
Overallotment			1.292991***
SIC 17	-0.7144059**	-0.7362066**	-0.77366**
SIC 20	-0.3286808	-0.3193812	-0.329136*
SIC 23	-0.5502882**	-0.482029*	-0.485722*
SIC 27	-0.762673**	-0.7393079**	-0.7127949**
SIC 33	-0.4385231**	-0.4328493**	-0.4607623**
SIC 35	-0.4312824**	-0.4174685**	-0.4295472**
SIC 36	-0.5774412***	-0.5523676***	-0.5411085***
SIC 37	-0.3703077*	-0.3817518**	-0.3930781**
SIC 38	-0.4720393**	-0.4322337**	-0.4311732**
SIC 39	-1.557453***	-1.495941***	-1.484365***

SIC 42	-0.641261***	-0.5791244***	-0.5731267***
SIC 44	-0.5465932*	-0.488046*	-0.4538193
SIC 46	0.5652727***	0.5418036**	0.5341925**
SIC 47	-0.4727077**	-0.4330609*	-0.4095011*
SIC 48	-0.4430064**	-0.4301542**	-0.4066496**
SIC 50	-0.33532*	-0.3245683	-0.3158332
SIC 53	0.695398***	0.6800487***	0.6476694***
SIC 57	-0.5335194**	-0.5040928**	-0.5218887**
SIC 70	-0.8433816***	-0.8583828***	-0.791866***
SIC 73	-0.3256915*	-0.2910589	-0.2768515
SIC 78	-0.6410808***	-0.5822673**	-0.5589841**
Constant	-0.1881588	-0.3619442**	-0.479634***
N	16,348	16,348	16,348
Pseudo R^2	0.0570	0.0675	0.0705

In table 10 the partial regression output is presented. Because of space-related issues, I decided to leave all dummies of two digit SIC out that were not significant. The entire table can be found in appendix C. If we compare the coefficient of underpricing on rehire in table 9 with the coefficient in table 10, we see that the effect on underpricing is similar. They are both significant at the 1% level. Most sectors have a negative impact on the decision to rehire, just the SIC codes 46 and 53 have a positive coefficient. The coefficient on SIC code 20 is not significant (but it is in the third regression, which is why it is presented here), all other dummies are significant at the 10%, 5% or 1% level. The explanation of the coefficients is the same as in table 9, for example, an underwriter that did an issue with average underpricing and for a firm mainly active in sector 39, would have a chance of just 2.83% to be rehired. An underwriter that did an issue with average underpricing and for a firm mainly active in sector 53 has a chance of 63.53% to be rehired. This indicates that underwriters in sector 53, which is general merchandise stores, would have a much higher chance to be rehired than underwriters in the sector 39, which are miscellaneous manufacturing industries. The number of observations is 16,348 and the pseudo R-squared is 0.0570.

The second regression also takes market share of an underwriter into account. The coefficient of underpricing is somewhat smaller compared to both the first regression as the regression without SIC dummies. The coefficient of market share is larger compared to the regression without dummies. Again, most dummies are negative and significant. The coefficients for SIC 20 and 73 are not significant. The coefficients for 46 and 53 are again positive. An underwriter with average market share who helped a firm in sector 39 with average underpricing now has a chance of 2.99% to be rehired. The difference is not so much. Being an average underwriter increases the chance of being rehired, but the sector and underpricing keep the chance low. Were that underwriter to do the same issue in sector 53, its chance of being rehired

would be 61.57%. This is lower than in the first regression. In this case, the market share does not do much for the chance of rehiring, although a chance of 61.57% is much higher than a chance of 2.99%.

The last regression includes overallotment. Would an underwriter have a higher chance of being rehired if it participated in stabilization practices after the previous offering? The coefficient of underpricing is lower compared to the regression in table 9, but higher than the coefficient in regression 2. The coefficient on market share is higher than the regression in table 9, but comparable to the coefficient in regression 2. The coefficient on overallotment is lower than in table 9. The coefficients on the SIC codes are again mainly negative and significant, apart from the coefficient on code 50 and 73. The coefficients on code 46 and 53 are again positive. The same underwriter as in the previous examples, thus with all average values, who did an issue for a firm in sector 39 now has a chance to be rehired of 3.03%. This shows that stabilization practices in a previous offering leads to a higher chance of being rehired in a next offering. If the underwriter would have done an offering for a firm in sector 53, the chance of rehiring would be 60.10%. This chance is again lower. The pseudo r-squared of this regression is 0.0705.

Altogether, these regressions show that underpricing has a negative effect on the chance of being rehired in a follow-on offering. When control variables are added, market share and overallotment, this effect stays negative and significant with about the same magnitude. Introducing dummies for all sectors gives more insight on which sectors have a high turnover of underwriters and which sectors are low. It appears that the sector an underwriter is active is, matters for the chance of being rehired. Stabilization practices of underwriters in the previous offering, as measured by overallotment, also have a positive impact on the probability of rehiring. Based on these results, I conclude that there seems to be a longer term relationship between issuer and underwriter, but that it is affected by the amount of underpricing. However, controlling for underwriter prestige, which is proxied for by market share, the relationship between IPO underpricing and the choice of an underwriter for a Follow-on offering does persist. Therefore, I have to reject the third hypothesis.

4.4 IPO cyclicality

Lastly, I want to test if there is such a thing as IPO cyclicality, or perhaps offer cyclicality. From figure 1, the conclusion can be drawn that IPO underpricing is very volatile. According to table B.1, the number of offers of IPOs differs per year. This is visualised in figure 2.

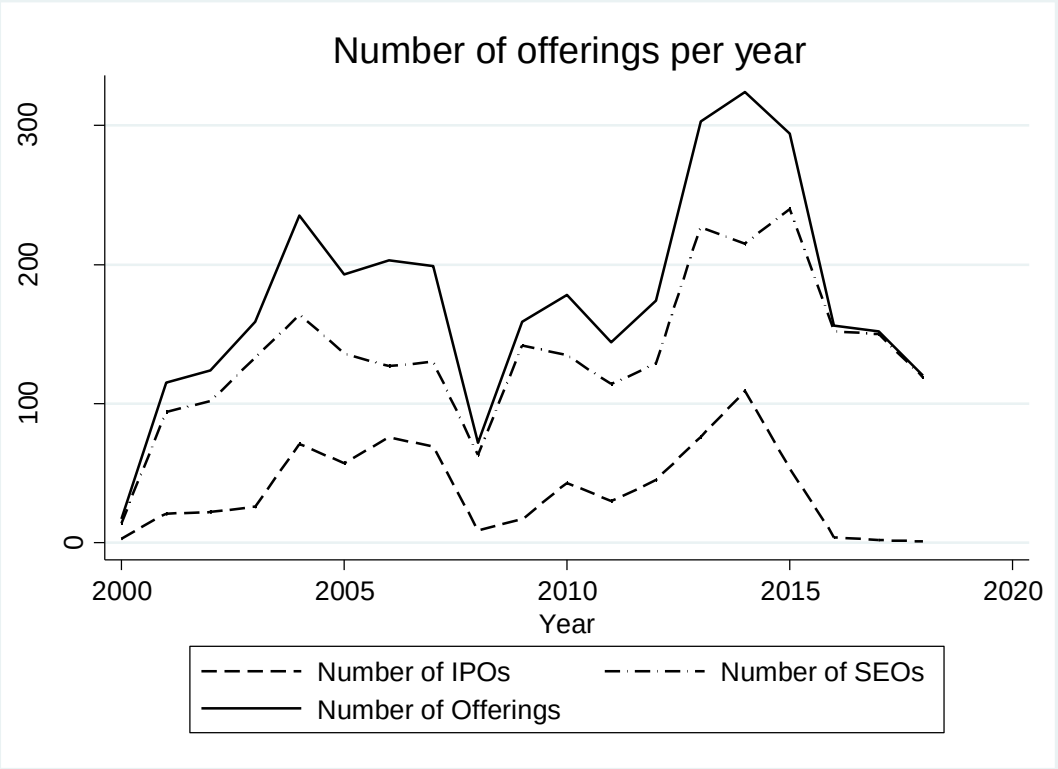

Figure 2 Number of offerings per year

Figure 2 shows the number of offerings per year for the entire offering, but also the subsample of Follow-on offerings and IPOs. Looking at this figure, it seems that there is some sort of cyclicality in offerings. The period 2001-2007 seems to have more offerings than average, just as the period 2011-2015. The average total number of offerings is 206.467, the average number of IPOs is 62.82313 and the average number of Follow-on offerings is 155.7077. In table 12 an overview is presented of the years in which the number of offerings was higher than the average.

Table 12 Difference in number of offerings in any given year with the average over the entire offering period.

Year	*Total offerings*	*IPOs*	*Follow-ons*
2000	-189	-60	-142
2001	-91	-42	-62
2002	-82	-41	-54
2003	-47	-37	-23
2004	29	8	8
2005	-13	-6	-20
2006	-3	13	-29
2007	-7	6	-26
2008	-134	-54	-93
2009	-47	-46	-14
2010	-28	-20	-21

2011	-62	-33	-42
2012	-32	-18	-27
2013	97	13	71
2014	118	46	59
2015	88	-9	84
2016	-50	-59	-4
2017	-54	-61	-6
2018	-86	-62	-37

The number of offerings in any year is compared to the average over the total sample period. With that, I am able to identify possible waves. The year 2004 has more offerings than the average, namely 29. Furthermore, the period 2013-2015 contains more offerings than average, indicating a potential wave. For IPOs, the year 2004 also contains a high number of offerings, but there is also a potential wave in 2006-2007, followed by a wave in 2013-2014. In the subsample of Follow-ons, there is the same pattern as in the total sample. Next, in table 13, I look for differences in average underpricing in the potential waves and the rest of the sample.

*Table 13 Underpricing in potential waves split per sample. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*IPOs*	*Follow-ons*
2004	0.0663707	0.1307561***	0.0287013
2006-2007	0.071445*	0.1405052***	0.0237847***
2013-2015 (for IPOs 2013-2014)	0.0793352***	0.1977924***	0.0282392
Non-wave years	0.0550389***	0.1554908	0.0304111

In the potential wave years, underpricing is higher than the average underpricing, except for 2004. This difference is statistical in the total sample for all possible waves. Note that underpricing was also higher in 2006-2007 when there was no higher number of offerings than the average. For IPOs, underpricing in 2004 is statistically significant different from the average. For the other wave-periods, the underpricing is statistical different from the average underpricing on the 1% level. For follow-on offerings, the wave in 2004 is not statistically significantly higher than the average underpricing. The wave in 2006 and 2007 is significant lower. For the wave 2013-2015 the difference is not statistically significant higher. In the non-wave years, the underpricing in the total sample is significantly lower than the average. For the both subsamples, average underpricing is not statistically significant from the average.

Looking at underpricing, these waves are a bit harder to distinguish. Looking at figure 1 and table 14, there are some waves visible. Significant positive differences of underpricing are coloured in blue, negative significant differences in red. For example, it seems that in the entire sample, there is a wave in 2012-2015,

followed by a period of less initial returns. The same wave is also visible in the subsample of IPOs. The subsample of Follow-ons does not contain many statistically significant differences, which already became clear from figure 1.

*Table 14 Differences with average in underpricing per year. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*IPOs*	*Follow-ons*
2000	-0.0062799	0.0560521***	-0.0105844***
2001	0.0802812***	0.0263794*	-0.0010906
2002	-0.0114274**	-0.0622127***	0.0006663
2003	0.0084145**	-0.005243	0.0151167***
2004	0.0016311	-0.0328449***	-0.0012656
2005	-0.0087925**	0.0597544***	-0.0022272
2006	0.0103336**	-0.0229792**	-0.0074751***
2007	0.0033634	-0.0232235	-0.0051259***
2008	-0.0265798***	-0.0360955	-0.0044997
2009	0.00042608	0.153387***	0.0020846
2010	-0.0271137***	-0.077587***	-0.0039208
2011	-0.0200881***	-0.072709***	0.003933
2012	0.017191***	0.0340671**	0.0008238
2013	0.0178964***	0.0524394***	-0.0019729
2014	0.0157887***	0.0190482	-0.0051939***
2015	0.0096848*	0.0784537***	0.0015989
2016	-0.0369775***	-0.210476***	-0.0007467
2017	-0.0271905***	0.2148056***	0.0040083*
2018	-0.0253055***	N/a	0.0094672***

Based on these results, I conclude that there are IPO waves in the period 2000-2018. Both the number of IPOs and the underpricing show some periods with more activity than usual, where usual is defined as the average over the entire period. Looking at the number of offerings, it becomes clear that there are two, possibly three, waves in the period 2000-2018, namely in 2006-2007 and 2013-2014. Also, the year 2004 shows more activity than usual. Looking at the underpricing, there is a possible wave in the period 2012-2015, with some single years with higher underpricing than usual. Therefore, I accept the fourth hypothesis which states that there is IPO cyclicality in the period 2000-2018. Concerning the total sample, there seems to be a wave in 2012/2013-2015. The subsample of Follow-ons shows in the number of offerings a wave in 2013-2015 and in underpricing 2017-2018, but this subsample shows a stable trend over time.

Finally, I wanted to check if IPO waves influence the probability of rehiring. To do that, I created an indicator variable called ‘wave’ that equals one if a year can be classified as a wave year according to table

12, and zero otherwise. This variable was added to the probit regressions of table 10, the results are presented in table 15.

*Table 15 Probit regressions of table 10, now with the variable wave. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*IPO sample*	*Follow-on sample*	*Total sample + market share*	*Total sample, market share + overallotment*
Underpricing	-2.594082***			-2.55286***	-2.900097***
Underpricing IPOs		0.1478513			
Underpricing Follow-ons			-0.991543***		
Marketshare				5.078793***	5.091896***
Overallotment					1.543481***
Wave	-0.0405446*	-0.7898349***	0.1494503***	-0.0329118	-0.0294015
Constant	-0.379707***	-2.551602***	-0.257358***	-0.513231***	-0.6547852***
N	16,383	4,263	12,120	16,383	16,383
Pseudo R^2	0.0333	0.0663	0.0039	0.0428	0.0472

The coefficient on the variable wave is negative in the regression on the total sample and significant at the 10% level. The coefficient stays negative when market share and overallotment are included, but loses significance. In the subsample of IPOs, wave has a much stronger, statistically significantly effect on the probability of rehiring. In the subsample of Follow-on offerings, this effect is positive and significant at the 1% level. The coefficient of underpricing, market share and overallotment is similar to the original regressions. Adding the variable of wave does not change much in the pseudo R-squared, apart from the second regression, where it goes from 0.0008 to 0.0663, meaning that adding the variable wave makes the model fit much better than only the model with underpricing.

What do these results mean? Apparently, in ‘hot’ IPO markets the probability of being rehired as an underwriter is lower compared to ‘normal’ or ‘cold’ IPO markets. When looking at the results of the total sample, regression 1, the probability of rehiring is 27.82 percent, with average underpricing. It is clear that wave years have a negative effect on the probability of rehiring, although the effect is not large and loses significance when the controls market share and overallotment are included.

4.5 Robustness check

4.5.1 Table 5

I want to check my findings using a different measure of underpricing. The new calculation of underpricing can be defined as:

$$Underpricing = \ln\left(\frac{Closing\ stock\ price\ end\ of\ 1st\ trading\ day}{Offer\ price}\right) \quad (7)$$

Using this measure, I replicate the most important tables in this thesis, namely the tables 5, 7, 8, 9, 10 and 11. The first results are presented in table 16, which is a replica of table 5.

*Table 16 Replica of table 5 with different measure of underpricing. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total underpricing	*Subsample IPOs*	*Subsample Follow-ons*
Age	-0.00008***	-0.0001131	0.000098***
Log(assets)	-0.0057499	0.0057417	-0.0018146
Log(EBITDA)	-0.0044632	-0.033373	-0.0039332*
Log(EBIT)	-0.0037748	0.0046713	-0.0016007
Log(Debt)	0.0000262	-0.0070627**	-0.0001854
Marketshare underwriters	-0.0187183	0.0201727	-0.0483744**
Number of proceeds	0.0009994	-0.0184037***	-0.0004775
S&P 500 return	-0.213294**	-1.588422***	0.0273518
Constant	0.1186878***	0.3123958***	0.0640742***
N	7,615	1,446	6,169
Adjusted R^2	0.0412	0.0565	0.0497
F-statistic	48.88	17.76	46.94

Comparing table 5 and table 16, some differences appear. The sign of the coefficients on age, assets, EBIT, debt, number of proceeds and the return on the S&P 500 is similar to the sign in the original regression. The sign on the coefficients of EBITDA and market share is different. Comparing the statistical significance, it becomes clear that the coefficients are less significant. Age is still significant at the 1% level. The coefficient is about half the size of the original coefficient. The variable log(assets) loses its significance but the coefficient becomes bigger. The coefficient on EBITDA stays insignificant but changes sign. The coefficients on EBIT and debt are comparable in size, sign and significance. Market share stays insignificant. The coefficient of the number of proceeds decreases. The S&P 500 return has a similar effect. Looking at the adjusted R-squared, it becomes obvious that this set of controls explains the original measure of underpricing better than this measure of underpricing. The F-statistic is 48.88, which is higher than in the original regression.

Looking at the subsample of IPOs, the results do not change much. Only the sign on the variables assets and EBIT differs. All other signs are the same and the magnitude of the coefficients is similar. The greatest difference is in significance and the adjusted R-squared, which is lower in table 16. The signs of the coefficients in the subsample of Follow-ons are the same as in table 5, and only the logarithm of EBITDA and market share become less significant. The Adjusted R-squared is higher in table 5. It becomes clear from all these results that the original measure of underpricing is better explained by these controls. The F-statistics are comparable.

4.5.2 Table 7, 8 and 9

Next, I look at table 7. This table deals with the effect of underpricing on market share. The results are duplicated in table 17.

*Table 17 Replication of table 7. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Entire sample	*Only IPOs*	*Only Follow-ons*
Underpricing	-0.0038868**		
Underpricing IPOs		0.0050491***	
Underpricing Follow-ons			-0.0310908***
Constant	0.0247087***	0.0225013***	0.0258329***
N	16,383	4,263	12,120
Adjusted R^2	0.0002	0.0014	0.004
F-statistic	5.15	6.57	27.06

Comparing table 17 and table 7, it becomes clear that using a different measure of underpricing does not have a much different effect on market share. The sign and size of the coefficients are similar, only the statistical significance is higher. The adjusted R-squared is higher for the entire sample, but lower in the two subsamples. The F-statistic for the entire sample is higher in table 17, but lower for the two subsamples.

Next, table 8 is recreated. The results are presented in table 18.

*Table 18 Replication of table 8. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	First lag	*Second lag*	*Third lag*	*First and second lag*	*All lags*
L_underpricing	-0.0052354***			-0.0053357***	-0.0054142***
L2_underpricing		-0.0051061***		-0.0052925***	-0.0056643***
L3_underpricing			-0.0049566***		-0.0044638**
Constant	0.0256176***	0.0261842***	0.0266634***	0.0264596***	0.0271876***
N	15,770	15,355	15,010	14,934	14,211

Adjusted R^2	0.0005	0.0005	0.0004	0.0010	0.0014
F-statistic	9.22	8.32	7.32	8.91	7.95

The effects of the first two lags are somewhat greater using this measure of underpricing compared to the original measure. Furthermore, it seems that using this measure of underpricing has a more significant effect on market share. The adjusted R-squared is also a bit larger for all regressions, except for the regression with the third lag, where it stays equal. For the first three regressions, the F-statistic is higher in table 18, but lower for the last two regressions.

Lastly, table 9 is duplicated. The results can be found in table 19. Only the regressions with underpricing are recreated.

*Table 19 Partial replication of table 9. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Underpricing and one lag	*Underpricing and two lags*
L_marketshare	0.9629688***	0.5610406***
L2_marketshare		0.4189014***
L_underpricing	-0.0009566**	-0.000483
L2_underpricing	-0.0002784	-0.0003294
L3_underpricing	0.0009039	0.0009063
Constant	0.009837***	0.0005358***
N	14,188	14,128
Adjusted R^2	0.9309	0.9429
F-statistic	6094.70	9518.18

Comparing the numbers, it becomes clear that the coefficients of the lags of market share are similar to table 9. The significance is also similar. The lags of underpricing are a bit different. The first lag has a bigger coefficient and is significant at the 5% level in the model with one lag of market share. The second lag has a smaller coefficient in both regressions but has the same sign. The third lag is also smaller, but has also a different sign. Comparing the adjusted R-squared, it shows that this measure of underpricing explains market share a bit better. The F-statistics in these regressions are higher.

4.5.3 Table 10 and 11

Lastly, I recreated table 10 and 11. The duplication of table 10 can be found in table 20.

Table 20 Replication of table 10

	Total sample	*IPO sample*	*Follow-on sample*	*Total sample + market share*	*Total sample, market share + overallotment*
Underpricing	-1.900746***			-1.878712***	-2.053936***
Underpricing IPO		0.2519663			
Underpricing Follow-on			-0.8440191***		
Marketshare				5.135292***	5.146872***
Overallotment					1.142274***
Constant	-0.4344594***	-2.778931***	-0.2139318***	-0.5659874***	-0.6736448***
N	16,383	4,263	12,120	16,383	16,383
Pseudo R^2	0.0219	0.0017	0.0012	0.0317	0.0343

The effect of underpricing on rehire is more positive with the alternative measure. The pseudo R-squared is higher in table 10 for the first, fourth and fifth regression. For the second and third regression, the alternative measure of underpricing has a better fit.

Lastly, table 11 is replicated, the results can be found in table 21.

*Table 21 Replication of table 11. Statistical significance is shown by asterix, * = 10%, **=5% and ***=1%*

	Total sample	*Total sample + market share*	*Total sample, market share + overallotment*
Underpricing	-1.821339***	-1.79807***	-1.938269***
Marketshare		5.518695***	5.528581***
Overallotment			0.8940216***
SIC 17	-0.7133967**	-0.7370351**	-0.7608455**
SIC 23	-0.5240997**	-0.4651695*	-0.4583977*
SIC 27	-0.7984875**	-0.774777**	-0.7600143**
SIC 33	-0.3995772**	-0.3953638**	-0.4107569**
SIC 35	-0.4059882**	-0.3936731**	-0.3986242**
SIC 36	-0.5607247***	-0.5358851***	-0.5259676***
SIC 37	-0.3340483*	-0.3460824*	-0.3501662*
SIC 38	-0.4769134***	-0.4374959**	-0.4361308**
SIC 39	-1.530089***	-1.470441***	-1.459709***
SIC 42	-0.6149483***	-0.5531281***	-0.5458558***
SIC 44	-0.5084778*	-0.4507837	-0.4230466
SIC 46	0.6264638***	0.6010515***	0.6016954***

SIC 47	-0.42252*	-0.3837279*	-0.3624546
SIC 48	-0.4048205**	-0.3928028**	-0.3728123**
SIC 53	0.6928366***	0.677019***	0.655357***
SIC 57	-0.5162386**	-0.4875876*	-0.4979364**
SIC 70	-0.8130638***	-0.828869***	-0.7806176***
SIC 73	-0.3231884*	-0.2893419	-0.2778553
SIC 78	-0.629193***	-0.5715901**	-0.5540437**
Constant	-0.2475127	-0.4208384**	-0.5081058***
N	16,348	16,348	16,348
Pseudo R^2	0.0471	0.0580	0.0594

Table 21 shows again, just like table 20, that this measure of underpricing has a more positive, yet still negative, effect on the probability of rehiring than the original measure. The coefficient of market share is comparable. The coefficient of overallotment is lower. The pseudo R-squared measure is lower in table 21 compared to table 11.

In conclusion, it is clear that using a slightly different measure of underpricing is not changing the results by much, it can be concluded that the results are robust.

5 Conclusion

In this thesis, I tried to find out if there is a long-term relationship between issuer and underwriter. IPO underpricing is a systematically phenomenon, and a lot of research has been done already on possible explanations of underpricing. Much of the previous literature focuses on these explanations, for example in the field of information asymmetry. However, the relationship between underwriter and issuer is less researched. In the process of an IPO, an investment bank figuring as underwriter has conflicting interests. On the one hand, there is the issuer, who wants to raise as much capital as possible. On the other hand, there are investors, who want the best possible deal out of an IPO. Choosing the side of the issuer could cost an underwriter a good relationship with investors. Choosing the side of the investor could cost the underwriter a good relationship with issuers, because issuers will not be happy when there is too much money left on the table, i.e. there is high underpricing. Since underwriters have to deal with this conflict, it is very interesting to see if they choose a side, and if they choose a side, which side they choose. My research question was:

Is there a long-term relationship between issuer and underwriter?

To answer this question, I executed a certain number of tests. The first test was a simple test to see if the sample indeed showed underpricing. It turns out, the offerings in my sample, which ran from 2000 to 2018, had a mean underpricing of 6.47%. The subsample of IPOs showed a higher average, namely 16.36%, and the subsample of Follow-ons show an average of 3.00%. A regression of underpricing on several control variables showed that the age of a firm, the size of the firm, the amount of debt before the offering and the S&P 500 return had a statistically significant negative effect on underpricing. The number of proceeds as specified in the prospectus has a positive effect. With these results, I could confirm the first hypothesis, namely that there is underpricing in the period 2000-2018.

Next, I looked at underwriter market share. The market share was regressed on underpricing to see if higher underpricing should lead to less market share for underwriters. It shows that there is indeed a negative impact of underpricing on underwriter market share, but this effect is very small. It even loses its impact when the lags of market share are included, showing that market share is persistent over time. I, however, accept the second hypothesis, which states that underwriter market share is negatively impacted by underpricing.

The third hypothesis stated that there is no relationship between IPO underpricing and the choice of an underwriter for a Follow-on offering when there was a control for underwriter prestige. For that, I did a probit regression where the dependent variable was an indicator variable indicating if a firm rehired the same underwriter for a next offering. Regressing this on underpricing shows that there is a strong negative relationship. If an underwriter is involved in an offering with average underpricing, the probability of being

rehired is 28.67%. Adding market share as a proxy for underwriter prestige does not change the significance nor the sign of the coefficient on underpricing, thereby proving the third hypothesis wrong.

The last hypothesis shed light on the cyclicality in the IPO market. Based on offerings and underpricing, there are a few cycles visible. The year 2004 had more offerings and higher underpricing than usual, so this year could be classified as a wave year. There is the wave in 2013-2015, based on the number of offerings. The IPO subsample also showed a wave in 2006-2007, just before the crisis. Based on IPO underpricing, there are several potential waves visible. Therefore, I accepted the last hypothesis. Adding an indicator for wave years to the probit regressions, shows that underwriters have a lower chance of being rehired in wave years, although this effect is small.

This thesis proves that there is a long-term relationship between issuers and underwriters, and that it can be disturbed by underpricing issues 'too much'. Stabilization activities and underwriter reputation increase the chances of being rehired as an underwriter.

This is a very interesting field of study. I have found some interesting results that give the opportunity for further research. For example, one could do further research to the effect of stabilization practices, or underwriter reputation. Also, a closer look to the sector effects, which I briefly touched upon, would be an intriguing field of study. I was not able to look closer into the underwriter reputation focus, because I could not find underwriter reputation data that was updated for my full sample. Therefore, I used my own proxy, market share. Also, some data was not complete, and in the merging process sometimes a lot of data got lost. Lastly, I could not find a variable that indicated rehiring, which should be somewhere in the SEC database, but probably in a part I could not access. I therefore had to create it myself, making it possibly noisy. The main take-away of this thesis is that underwriters have to take the wishes of their client, the issuers, seriously. A little underpricing is not bad, but more underpricing leads to a lower probability of being rehired. The field of IPO underpricing and all related issues remains very intriguing and I am sure that the last word has not yet been written on it.

REFERENCES

Aggarwal, R. (2003). Allocation of initial public offerings and flipping activity. *Journal of Financial Economics, 68*(1), 111-135.

Allen, F., & Faulhaber, G. R. (1989). Signalling by underpricing in the IPO market. *Journal of Financial Economics, 23*(2), 303-323.

Alti, A. (2005). IPO market timing. *The Review of Financial Studies, 18*(3), 1105-1138.

Alti, A. (2006). How persistent is the impact of market timing on capital structure? *The Journal of Finance, 61*(4), 1681-1710.

Asquith, D., Jones, J. D., & Kieschnick, R. (1998). Evidence on price stabilization and underpricing in early IPO returns. *The Journal of Finance, 53*(5), 1759-1773.

Baker, M., & Wurgler, J. (2002). Market timing and capital structure. *The Journal of Finance, 57*(1), 1-32.

Baron, D. P. (1982). A model of the demand for investment banking advising and distribution services for new issues. *The Journal of Finance, 37*(4), 955-976.

Barry, C. B., & Brown, S. J. (1984). Differential information and the small firm effect. *Journal of Financial Economics, 13*(2), 283-294.

Barry, C. B., Muscarella, C. J., & Vetsuypens, M. R. (1991). Underwriter warrants, underwriter compensation, and the costs of going public. *Journal of Financial Economics, 29*(1), 113-135.

Bayley, L., Lee, P. J., & Walter, T. S. (2006). IPO flipping in Australia: cross-sectional explanations. *Pacific-Basin Finance Journal, 14*(4), 327-348.

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.

Benveniste, L. M., & Spindt, P. A. (1989). How investment bankers determine the offer price and allocation of new issues. *Journal of Financial Economics, 24*(2), 343-361.

Benveniste, L. M., Busaba, W. Y., & Wilhelm Jr, W. J. (1996). Price stabilization as a bonding mechanism in new equity issues. *Journal of Financial Economics, 42*(2), 223-255.

Binay, M. M., Gatchev, V. A., & Pirinksy, C. A. (2007). The role of underwriter-investor relationships in the IPO process. *Journal of Financial and Quantitative Analysis, 42*(3), 785-809.

Boehmer, E., & Fishe, R. P. (2000). Do Underwriters Encourage Stock Flipping? A new Explanation for the Underpricing of IPOs. *Working Paper. University of Miami.*

Booth, J. R., & Chua, L. (1996). Ownership dispersion, costly information, and IPO underpricing. *Journal of Financial Economics, 41*(2), 291-310.

Campbell, T. S., & Kracaw, W. A. (1980). Information production, market signalling, and the theory of financial intermediation. *The Journal of Finance, 35*(4), 863-882.

Carter, R., & Manaster, S. (1990). Initial public offerings and underwriter reputation. *The Journal of Finance, 45*(4), 1045-1067.

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.

Chalk, A. J., & Peavy III, J. W. (1987). Initial public offerings: daily returns, offering types and the price effect. *Financial Analysts Journal, 43*(5), 65-69.

Chemmanur, T. J., & Krishnan, K. (2012). Heterogeneous beliefs, IPO valuation, and the economic role of the underwriter in IPOs. *Financial Management, 41*(4), 769-811.

Chiang, Y. M., Hirshleifer, D., Qian, Y., & Sherman, A. E. (2011). Do investors learn from experience? Evidence from frequent IPO investors. *The Review of Financial Studies, 24*(5), 1560-1589.

Clarkson, P. M. (1994). The underpricing of intitial public offerings, ex ante uncertainty, and proxy selection. *Accounting & Finance, 34*(2), 67-78.

Dolvin, S. D., & Jordan, B. D. (2008). Underpricing, overhang, and the cost of going public to preexisting shareholders. *Journal of Business Finance & Accounting, 35*(3-4), 434-458.

Dunbar, C. G. (2000). Factors affecting investment bank initial public offering market share. *Journal of Financial Economics, 55*(1), 3-41.

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.

Engelen, P. J., & Van Essen, M. (2010). Underpricing of IPOs: Firm-, issue-and country-specific characteristics. *Journal of Banking & Finance, 34*(8), 1958-1969.

Espenlaub, S., & Tonks, I. (1998). Post-IPO directors' sales and reissuing activity: An empirical test of IPO signalling models. *Journal of Business Finance & Accounting, 25*(9-10), 1037-1079.

Fernando, C. S., Gatchev, V. A., & Spindt, P. A. (2005). Wanna dance? How firms and underwriters choose each other. *The Journal of Finance, 60*(5), 2437-2469.

Fishe, R. P. (2002). How stock flippers affect IPO pricing and stabilization . *Journal of Financial and Quantitative Analysis, 37*(2), 319-340.

Griffith, S. J. (2003). Spinning and Underpricing - A Legal and Economic Analysis of the Preferential Allocation of Shares in Initial Public Offerings. *Brooklyn Law Review, 69*(2), 583-662.

Guo, R. J., Lev, B., & Shi, C. (2006). Explaining the Short-and Long-Term IPO Anomalies in the US by R&D. *Journal of Business Finance & Accounting, 33*(3-4), 550-579.

Helwege, J., & Liang, N. (2004). Initial public offerings in hot and cold markets. *Journal of Financial and Quantitative analysis, 39*(3), 541-569.

Hopp, C., & Dreher, A. (2013). Do differences in institutional and legal environments explain cross-country variations in IPO underpricing? *Applied Economics, 45*(4), 435-454.

Ibbotson, R. G. (1975). Price performance of common stock new issues. *Journal of Financial Economics, 2*(3), 235-272.

Ibbotson, R. G., & Jaffe, J. F. (1975). "Hot issue" markets. *The Journal of Finance, 30*(4), 1027-1042.

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1988). Initial public offerings. *Journal of Applied Corporate Finance, 1*(2), 37-45.

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1994). The market's problems with the pricing of initial public offerings. *Journal of Applied Corporate Finance, 7*(1), 66-74.

James, C., & Wier, P. (1990). Borrowing relationships, intermediation, and the cost of issuing public securities. *Journal of Financial Economics, 28*(1-2), 149-171.

Kennedy, D. B., Sivakumar, R., & Vetzal, K. R. (2006). The implications of IPO underpricing for the firm and insiders: Tests of asymmetric information theories. *Journal of Empirical Finance, 13*(1), 49-78.

Krigman, L., Shaw, W. H., & Womack, K. L. (2001). Why do firms switch underwriters? *Journal of Financial Economics, 60*(2-3), 245-284.

Lewellen, K. (2006). Risk, reputation, and IPO price support. *The Journal of Finance, 61*(2), 613-653.

Ljungqvist, A. (2007). IPO underpricing. In *Handbook of Empirical Corporate Finance* (pp. 375-422). Elsevier.

Logue, D. E. (1973). On the pricing of unseasoned equity issues: 1965-1969. *Journal of Financial and Quantitative Analysis, 8*(1), 91-103.

Loughran, T., & Ritter, J. R. (1995). The new issues puzzle. *Journal of Finance, 50*(1), 23-51.

Loughran, T., & Ritter, J. R. (2004). Why has IPO underpricing changed over time? *Financial Management*, 5-37.

Lowry, M. (2003). Why does IPO volume fluctuate so much? *Journal of Financial Economics, 67*(1), 3-40.

Lowry, M., & Schwert, G. W. (2002). IPO market cycles: Bubbles or sequential learning? *The Journal of Finance, 57*(3), 1171-1200.

Marsh, P. (1982). The choice between equity and debt: An empirical study. *The Journal of Finance, 37*(1), 121-144.

McDonald, J. G., & Fisher, A. K. (1972). New-issue stock price behavior. *The Journal of Finance, 27*(1), 97-102.

McFadden, D. (1973). Conditional Logit Analysis of Qualitative Choice Behavior. (P. Zarembka, Ed.) *Frontiers in Econometrics*, 105-142.

Miller, R. E., & Reilly, F. K. (1987). An examination of mispricing, returns, and uncertainty for initial public offerings. *Financial Management, 16*(2), 33-38.

Muscarella, C. J., & Vetsuypens, M. R. (1989). A simple test of Baron's model of IPO underpricing. *Journal of Financial Economics, 24*(1), 125-135.

Nanda, V., & Yun, Y. (1997). Reputation and financial intermediation: an empirical investigation of the impact of IPO mispricing on underwriter market value. *Journal of Financial Intermediation, 6*(1), 39-63.

Nielsson, U., & Wójcik, D. (2016). Proximity and IPO underpricing. *Journal of Corporate Finance, 38*, 92-105.

Pagano, M., Panetta, F., & Zingales, L. (1998). Why do companies go public? An empirical analysis. *The Journal of Finance, 53*(1), 27-64.

Pástor, L'., & Veronesi, P. (2005). Rational IPO waves. *The Journal of Finance, 60*(4), 1713-1757.

Reilly, F. K. (1973). Further evidence on short-run results for new issues investors. *Journal of Financial and Quantitative Analysis, 8*(1), 83-90.

Reilly, F. K., & Hatfield, K. (1969). Investor experience with new stock issues. *Financial Analysts Journal*, *25*(5), 73-80.

Ritter, J. R. (1991). The long-run performance of initial public offerings. *The Journal of Finance*, *46*(1), 3-27.

Ritter, J. R., & Welch, I. (2002). A review of IPO activity, pricing, and allocations. *The Journal of Finance*, *57*(4), 1795-1828.

Ruud, J. S. (1993). Underwriter price support and the IPO underpricing puzzle. *Journal of Financial Economcs*, *34*(2), 135-151.

Rydqvist, K. (1997). IPO underpricing as tax-efficient compensation. *Journal of Banking & Finance*, *21*(3), 295-313.

Schultz, P. H., & Zaman, M. A. (1994). Aftermarket support and underpricing of initial public offerings. *Journal of Financial Economics*, *35*(2), 199-219.

Stoll, H. R., & Curley, A. J. (1970). Small business and the new issues market for equities. Journal of financial and quantitative analysis, 5(3), 309-322.

Su, D., & Fleisher, B. M. (1999). An empirical investigation of underpricing in Chinese IPOs. *Pacific-Basin Finance Journal*, *7*(2), 173-202.

Taranto, M. A. (2003). Employee stock options and the underpricing of initial public offerings. *Unpublished Working Paper. University of Pennsylvania*.

Wilhelm Jr, W. J. (1999). Secondary market stabilization of IPOs. *Journal of Applied Corporate Finance*, *12*(1), 78-85.

Wilhelm Jr, W. J. (2005). Bookbuilding, Auctions, and the Future of the IPO Process. *Journal of Applied Corporate Finance*, *17*(1), 55-66.

Yung, C., Çolak, G., & Wang, W. (2008). Cycles in the IPO market. *Journal of Financial Economics*, *89*(1), 192-208.

APPENDIX A Variable descriptions

Table A.1 shows all variables used in the regressions or in the creation of variables used in the regressions.

Table A 1 Variable descriptions

Variable name	*Description*
Age	Age of the issuing company, calculated as the difference of the year of issuing and founding.
Numberofproceeds	The number of uses of proceeds as listed in the prospectus
OfferPrice	The offer price of the issued shares
SharesOfferedsumofallMkt	Number of shares offered
ProceedsAmtSumofallMkts	Proceeds of the issue
OriginalMiddleofFiling	Middle of price range at which the offer price is expected
StockPrice1DayAfter	Closing stock price (US$) on primary exchange 1 business day after Trade Date
StockPriceatCloseofOffer1	Closing stock price (US$) on the primary exchange for the first day that the stock traded
AllManagersRoleDescription	Descriptions listed down the page indicating the specific role of each manager on the transaction
AllManagers	Full names of all managers listed down the page
UnderwritingFeeasofPrncpl	Portion of underwriting fee to be paid to the lead and co-managers who were part of the purchasing group, expressed as a percentage of principal amount.
UnderwritingFee	Portion of underwriting fee, expressed in dollars per share or bond, to be paid to the lead and co-managers who were part of the purchasing group
Underpricing_all	Total underpricing in the dataset
Underpricing_ipo	Underpricing in the IPOs
Underpricing_follow	Underpricing in any Follow-on offering
Num_mgrs	The number of managers in the syndicate of an offering
TotalAssetsBeforethe	Total assets before the offering (US $ mil)
EBITDABeforeOfferingUSmil	EBITDA before the offering
EBITLastTwelveMonthsBeforeO	EBIT before the offering
Dt	Total debt – including current
Rehire	Indicator variable indicating if same underwriter is hired in a follow-on issue

APPENDIX B Number of issues

In table B.1 an overview of the number of issues per year for the whole sample as well as the subsamples of only IPOs and Follow-ons is presented. Numbers between parentheses represent issues with missing data for underpricing.

Table B 1Number of issues per year, split up by IPO and Follow-on. Number in parentheses is number of issues with missing data for underpricing

Year	*IPOs*	*Follow-ons*	*Total*
2000	3	14	17
2001	21 (1)	94	115 (1)
2002	22	102	124
2003	26 (1)	133	159 (1)
2004	71	164	235
2005	57 (3)	136	193 (3)
2006	76 (3)	127	203 (3)
2007	69	130	199
2008	9 (1)	63	72 (1)
2009	17 (6)	142 (1)	159 (7)
2010	43 (17)	135	178 (17)
2011	30 (15)	114	144 (15)
2012	45 (12)	129	174 (12)
2013	76 (5)	227	303 (5)
2014	109 (8)	215	324 (8)
2015	54 (1)	240 (1)	294 (2)
2016	4	152	156
2017	2	150	152
2018	1 (1)	119	120 (1)
Total	**735 (74)**	**2,586 (2)**	**3,321 (76)**

APPENDIX C Probit regression total

Table C.1 shows the full regression model used in section 4.3.

Table C. 1 Full regression model for the probit regressions with dependent variable rehire and independent variables underpricing, market share, overallotment and sic-dummies

	(1)	*(3)*	*(4)*
Underpricing	-2.489783***	-2.446182***	-2.741749***
Market share		5.481021***	5.491282***
Overallotment			1.292991***
SIC 12	-0.2070356	-0.2132115	-0.2284539
SIC 13	0.0190662	0.0853742	0.0767547
SIC 14	0.0034954	0.0308758	0.0044409
SIC 15	-0.2259412	-0.2304933	-0.2324665
SIC 16	-0.2181697	-0.1290737	-0.1304633
SIC 17	-0.7144059**	-0.7362066**	-0.77366**
SIC 20	-0.3286808	-0.3193812	-0.329136*
SIC 23	-0.5502882**	-0.482029*	-0.485722*
SIC 24	0.0635998	0.0234744	0.032276
SIC 25	-0.411644	-0.418815	-0.4619468
SIC 26	-0.0726836	-0.0668041	-0.0887702
SIC 27	-0.762673**	-0.7393079**	-0.7127949**
SIC 28	-0.0849264	-0.044963	-0.0463164
SIC 29	-0.1829644	-0.1693215	-0.1828549
SIC 30	0.1179907	0.145561	0.1672037
SIC 31	0.4815452	0.4799314	0.541319
SIC 32	-0.3872933	-0.3904045	-0.4023921
SIC 33	-0.4385231**	-0.4328493**	-0.4607623**
SIC 34	-0.3234512	-0.3104724	-0.2890064
SIC 35	-0.4312824**	-0.4174685**	-0.4295472**
SIC 36	-0.5774412***	-0.5523676***	-0.5411085***
SIC 37	-0.3703077*	-0.3817518**	-0.3930781**
SIC 38	-0.4720393**	-0.4322337**	-0.4311732**
SIC 39	-1.557453***	-1.495941***	-1.484365***
SIC 41	-04283376	-0.4978682	-0.5082577
SIC 42	-0.641261***	-0.5791244***	-0.5731267***
SIC 44	-0.5465932*	-0.488046*	-0.4538193
SIC 45	-0.1987321	-0.2295505	-0.2335252
SIC 46	0.5652727***	0.5418036**	0.5341925**
SIC 47	-0.4727077**	-0.4330609*	-0.4095011*
SIC 48	-0.4430064**	-0.4301542**	-0.4066496**

SIC 50	-0.33532*	-0.3245683	-0.3158332
SIC 51	-0.0975253	-0.06466	-0.0573843
SIC 52	-0.2210717	-0.2308117	-0.1835101
SIC 53	0.695398***	0.6800487***	0.6476694***
SIC 54	-0.0999937	-0.0739698	-0.1179136
SIC 55	0.0507828	0.0596667	0.0241313
SIC 56	-0.1811032	-0.1688342	-0.1591176
SIC 57	-0.5335194**	0.5040928**	-0.5218887**
SIC 58	0.0742171	0.1291607	0.1330309
SIC 59	-0.1219304	-0.112412	-0.1107353
SIC 70	-0.8433816***	-0.8583828***	-0.791866***
SIC 73	-0.3256915*	-0.2910589	-0.2768515
SIC 78	-0.6410808***	-0.5822673**	-0.5589841**
SIC 79	-0.1904119	-0.1727452	-0.1924595
SIC 80	-0.2460037	-0.233478	-0.245532
SIC 82	-0.2722727	-0.2708061	-0.2011467
SIC 83	0.5461795	-0.6186331	-0.5325341
SIC 87	-0.1959895	-0.1571861	-.1531173
Constant	-0.1881588	-0.3619442**	-0.479634***
N	16,348	16,348	16,348
Pseudo R^2	0.0570	0.0675	0.0705