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The Role of Independent Financial Advisors in the IPO Process

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ABSTRACT

The European Initial Public Offering (IPO) market has seen an important innovation within the last decade: the increasing participation of Independent Financial Advisors (IFA) in the IPO process. Using data from 373 Western European IPOs between January 2012 and February 2019, this paper applies a multivariate regression model to examine the potential impact of IFAs on IPO underpricing, a phenomenon that refers to the persistence of significant, positive initial returns for shares issued in an IPO. The analysis presented shows that firms which engaged an IFA for their IPO exhibit significantly lower underpricing than firms that did not. Specifically, the presence of an IFA leads to a substantial reduction in underpricing of approximately 3.4 percentage points. Moreover, offer price accuracy of the issued shares is significantly higher for IPOs advised by an IFA. These results suggest a beneficial effect of IFAs on IPO pricing. A binary response model is applied to the data, identifying common patterns in firm characteristics, to examine what type of companies appoint an IFA. The applied probit model suggests that larger firms, pre-IPO Venture Capital owned firms, and firms belonging to the financial industry are significantly more likely to appoint an IFA.

Keywords: *Financial Advisor, Initial Public Offering, Underpricing, Asymmetric Information*

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1. Introduction

> *"The independent adviser's opportunity is based on trying to perpetuate the idea of mistrust. What independent advisers add is no more than what banks would offer companies otherwise."*
>
> - Anonymous fund manager (Agnew and Massoudi, 2014, paragraph 15)

Over the last decade, the market for Initial Public Offerings (IPO) has seen a new type of actor entering the market, so-called Independent Financial Advisors (IFA). Historically focused on offering advice in the context of mergers & acquisitions, companies such as *Lazard, Rothschild,* and *STJ Advisors* have been increasingly able to get involved in the process of a conventional, bookbuilt IPO in the European markets. IFAs advise issuing companies on topics such as the decision to go public, the selection of the underwriter syndicate, and the determination of the final offer price. They can be distinguished from traditional investment banks by primarily two characteristics: First, they do not possess the capacities to underwrite shares but can solely offer advice to companies. In other words, IFAs sell a supplementary service rather than replacing investment banks in their function. Second, IFAs do not offer sales and trading services that make up a core revenue stream for investment banks.

The supplementary nature of IFAs' services has led financial experts to call into question the benefits provided by these services. As in the quote above, IFAs are often accused of merely adding unnecessary costs and complexity to the IPO process without offering anything not already covered by investment banks (Agnew and Massoudi, 2014). IFAs themselves, however, argue that they add value by leveraging their independence to mitigate the potential conflict of interest between investment banks and issuing companies. This conflict of interest may arise from investment banks' long-term client relationships with institutional investors. Given the importance of these clients for investment banks' revenues, the banks are placed in a situation of moral hazard. Specifically, they have a strong incentive to advocate an offer price for the company's newly issued shares below their 'true' value and subsequently lobby for a favorable share allocation on behalf of their institutional clients (e.g. Goldstein et al., 2011; Loughran and Ritter, 2002; Reuter 2006). While this 'quid pro quo' is beneficial to investment banks and their clients, it implies costs for both issuing companies and pre-IPO owners in terms of 'money left on the table' (Habib and Ljungqvist, 2001). IFAs argue that they can alleviate the negative effects of this scenario.

The practice of issuing shares below their 'true' value is called underpricing and has been the subject of extensive academic research (Lowry et al., 2017). While its persistence across regions and time periods remains a puzzle (Loughran et al., 2019), several theories have been developed to explain the underpricing phenomenon. One of these theories that has received strong empirical support emphasizes the information asymmetry and resulting agency conflict between investment banks and issuing companies referred to above (e.g. Reuter, 2006). It seems evident that an important selling point of IFAs is based on the premises of this theory. The increasing reliance on IFAs observed over the last few years (Jenkinson et al., 2018) suggests that firms consider them a potential solution to this agency conflict. The importance of this topic is further elevated by its practical relevance for firms going public: Executives interviewed within the scope of existing IPO literature have consistently indicated their concern about the agency conflict as an important cause for underpricing (Brau and Fawcett, 2006; van den Assem et al., 2017).

Surprisingly, the role of IFAs in the IPO process has not yet been extensively analyzed in the academic literature. This paper can thus be regarded as a first attempt to shed some light on a still nascent field of research that is likely to gain more attention in the future. Two main research questions guide the analysis and critical evaluation of the role of IFAs in the IPO process presented in this paper:

I. *"Does the involvement of an IFA in the IPO process lead to a beneficial effect on IPO pricing for companies going public?"*
II. *"Do companies that appoint an IFA differ in their firm-specific characteristics from companies that do not engage an IFA?"*

In this paper, these two questions are analytically explored based on a sample of 373 Western European IPOs undertaken between January 2012 and February 2019. The first question is analyzed in two steps: First, the effect of appointing an IFA on the expected level of underpricing is examined. Both a multivariate *Ordinary Least Squares* (*OLS*) and *Weighted Least Squares* (*WLS*) regression are performed with underpricing as the dependent and IFA as the explanatory variable, while controlling for other factors such as firm- and industry-specific effects. The results demonstrate that IFAs have a highly significant, mitigating effect on underpricing. This observed effect is substantial: For the average IPO company in the sample, the presence of an IFA reduces underpricing from 8.3% to 4.9%. Based on the average amount of proceeds raised in the sample, this reduction equals approximately 8 million euros of additional proceeds. As a benchmark, investment banks in Europe charge IPO fees between 2% and 4% of proceeds

raised (Abrahamson et al., 2011). This comparison exemplifies the extent of IFAs' mitigating effect, as it is similar in magnitude to the costs incurred by a company for receiving underwriting services by investment banks.

Building on this initial analysis, in a second step, the impact of IFAs on offer price accuracy is analyzed. In other words, it is examined whether IFAs reduce the likelihood of particularly high under- or overpricing (i.e. negative first day initial returns), both of which are undesirable for an issuing company. Since the mitigating effect established during the first stage of the analysis could in theory also be driven by incidents of significant overpricing, it is important to test the impact of IFAs on price accuracy more generally. The potential effects of IFAs on price accuracy are therefore tested through a *Breusch-Pagan* and a *Variance Ratio Test*. Both tests strongly support the hypothesis that IFAs improve price accuracy. Together, the results from both stages of the analysis suggest that IFAs have both a mitigating effect and improve offer price accuracy. Consequently, novel and convincing empirical evidence in favor of IFAs' beneficial impact on IPO pricing is presented in this paper.

The second research question is explored by applying a binary response (*probit*) model. It examines which firm characteristics affect the likelihood of a company to appoint an IFA, i.e. which type of companies engage an IFA. The variables employed in the model were primarily derived from expert interviews conducted by the authors (refer to Appendix F). The *probit* model's results suggest that three factors have a highly significant, positive effect: (i) the size of the issuing company, (ii) the presence of a Venture Capital (VC) investor as a pre-IPO shareholder, and (iii) an affiliation of the issuing company to the financial industry. Potential explanations are as follows: The positive impact of a company's size could be related to the fee structure of IFAs. This structure makes it economically unfeasible for small firms to appoint IFAs (i). The positive impact of VC ownership is considered a consequence of VCs' financial sophistication, as suggested by the experts interviewed (refer to Appendix F). Since VCs frequently exit investments through IPOs, they are more educated on the complexities of the IPO process and the potential conflicts of interest related to it (ii). The impact of an affiliation to the financial industry could be due to the increased level of financial sophistication of the respective issuing company (iii).

This paper contributes to the existing body of IPO underpricing literature in several ways: It is the first study to show that IFAs have a significant, robust effect on IPO pricing, and thus provides a basis for future research into this topic. Furthermore, the results have practical implications as they show that appointing IFAs can provide measurable benefits. These benefits,

however, seem to be restricted to large companies, since the marginal costs of hiring an IFA appear to exceed marginal benefits for smaller companies. This insight has important economic implications, as it means that companies below a certain size threshold are essentially excluded from the IFA market and its benefits.

The remainder of this paper is organized as follows: Section 2 provides the theoretical framework relevant to the topic and introduces the role of IFAs in the IPO process. Existing literature relevant to the topic is outlined and discussed. Section 3 states the hypotheses to be explored, followed by a description of the sample and the research design that is applied to test these hypotheses empirically in Section 4. Section 5 discusses and evaluates the findings of the analyses. Section 6 outlines the robustness checks that were applied to the results. Finally and before the paper concludes, Section 7 illustrates the limitations of the derived results.

2. Theoretical Framework

This section provides the theoretical background from which the hypotheses in Section 3 are derived. The IPO process in Europe is described, followed by a summary of the most common theories concerning IPO underpricing. Subsequently, the role of IFAs in the IPO process, their responsibilities and their potential impact on underpricing are analyzed in Section 2.3.

2.1. The IPO Process in Europe

This section outlines the process of taking a company public through a bookbuilding mechanism on a European stock exchange. It will not discuss alternative IPO mechanisms such as auctions and fixed-price offerings since bookbuilding remains both the dominant mechanism applied in practice and the one relevant for this paper (Ljungqvist et al., 2003; Busaba and Chang, 2010). Emphasis is laid on the steps in the process that are most relevant in the context of IFAs. As illustrated in Figure 1 below, the standard process entails four major phases (Jenkinson and Jones, 2009a): the underwriter selection phase, the pre-marketing phase, the bookbuilding phase, and the post-IPO phase.

Figure 1: Timeline of a Typical Bookbuilding IPO Process in Europe

The figure below depicts the IPO process in Europe step by step. The figure is based on Jenkinson et al. 2006.

2.1.1. Underwriter Selection

While it should be noted that the IPO process in its entirety begins with the company deciding to go public, this decision is taken as a prerequisite within the scope of this paper. In a first step, certain terms that are used throughout the IPO literature must be defined.[1] In a bookbuilt IPO, the company first selects one or more investment banks to form an underwriting syndicate. Within the syndicate, each bank assumes different roles of different significance. The role of the bookrunner(s) is considered the most important and most desirable. The bookrunner manages the order book that collects the bids submitted by the investors during the bookbuilding phase (refer to Section 2.1.3 below for more information). More importantly, the bookrunner holds the most sway over the final allocation of shares and gets credit for the IPO in the investment banking league tables. In most IPOs, one of the bookrunners also assumes the most senior role with respect to coordinating the IPO process as global coordinator. This role encompasses tasks such as coordinating the different regional tranches in a listing on several exchanges (Jenkinson and Jones, 2009a). The lead manager is second in the hierarchy and also takes on significant responsibilities in the process.[2] The other members of the underwriter syndicate are usually referred to as co-managers and are mainly entrusted with tasks such as providing analyst coverage and/or assisting the issuer in the placement of shares with investors. Particularly large IPOs might also include several non-managing underwriters that provide additional support to the syndicate in the share placement process.

The company usually chooses its underwriters in a competitive process referred to as 'bake-off' or 'beauty contest'. The potential underwriters pitch their strategy for a successful IPO, provide an indicative valuation range of the share price, and emphasize their competitive advantages over other investment banks. Investment banks compete on factors such as their sector expertise and their relationships with reputable institutional investors. Several studies have analyzed the factors that companies deem important when choosing underwriters. In a survey of CFOs, an underwriter's overall reputation, the reputation of an underwriter's analysts/research department, its industry expertise, and its post-IPO services such as market-making and liquidity provision are found to be the most important factors (Brau and Fawcett, 2006). Other studies corroborate these results (Krigman et al., 2001; van den Assem et al., 2017). The fact that reputation is the most important criterion in all three surveys is not surprising as underwriters'

[1] The terms used to describe the different roles for investment banks in the IPO underwriter syndicate throughout this paper rely on the commonly used definitions, as for example put forward in Hu and Ritter (2007).
[2] In case of several lead managers, the term 'joint-lead managers' is frequently used (Jenkinson and Jones, 2009a). It should be noted that in some IPOs the role of bookrunner and lead manager is split.

reputation is meant to serve as a credible signal of the company's quality (Booth and Smith, 1986; Carter and Manaster, 1990). As highlighted by Corwin and Schultz (2005), there has been and continues to be a clear trend towards relying on multiple underwriters. They explain this trend by referring to the larger size of the average IPO and the increased information production in underwriting syndicates as a benefit of relying on more than one underwriter.

The 'bake-off' is concluded by the selection of the bookrunner(s) and other syndicate member(s), as well as by the drafting of the 'letter of intent'. This document serves to specify important aspects of the process such as the underwriters' compensation fee (called the 'gross spread') but does not include any guarantees regarding the final offer price (Ellis et al., 2000). As stated in Abrahamson et al. (2011), the 'gross spread' in Europe usually lies between 2% and 4%. These fees are usually allocated using a so-called 1:1:3 split (Torstila, 2001). Specifically, the gross spread is split into a management fee (20%), underwriting fee (20%), and selling concessions (60%). It should be noted that the underwriter selection process is not simply a 'one-way' procedure, since very reputable investment banks can afford to be selective with respect to the companies they are willing to underwrite, so as to protect their own reputation.

2.1.2. Pre-Marketing Phase

The central purpose of the pre-marketing phase is the collection and analysis of information related to the issuing firm. This information gathering/analysis is called legal, commercial and financial due diligence. It is carried out with the support of additional advisors such as law and accounting firms, which are usually selected by the global coordinator or the lead manager (Gajewski and Gresse, 2006). The obtained information is used to create the preliminary prospectus and to advise the issuer on crucial factors such as timing, pricing, and the size of the offering. Moreover, the information is incorporated in the so-called 'research reports' created by the underwriters' analyst team. These reports are then sent to important institutional clients of the underwriters to generate interest in the IPO among the investor community (Jenkinson and Jones, 2004). At the same time, global coordinators and lead managers prepare the 'road show' that is held during the bookbuilding phase.

Once the underwriters and the company deem the collected information sufficient, the preliminary prospectus, including the initial price range, is submitted to the responsible financial authorities as a mandatory part of the company's request for an initial listing on the respective stock exchange. Within the European Union, IPO prospectus are standardized to a large extend since the EU Prospectus Directive (Directive 2003/71/EC, 2003) was passed in 2005 as a measure to integrate European capital markets (Gajewski and Gresse, 2006). The pre-marketing

phase is completed after all amendments requested by the financial authority have been incorporated and the preliminary prospectus approved (Ellis et al., 2000). The pre-marketing phase is succeeded by two important events, the commencement of trading activities on the so-called 'when-issued-market' and the bookbuilding phase. Since the former is not considered relevant within the scope of this paper, the section continues with the bookbuilding phase.

2.1.3. Bookbuilding Phase

The bookbuilding phase begins with the road show. It describes a period of 2-4 weeks during which high level executives of the firm together with the underwriters seek to generate interest in the IPO by giving presentations to and holding meetings with potential investors. A typical road show comprises meetings with both retail brokers and institutional investors (Ellis et al. 2000). An investor survey conducted by Jenkinson and Jones (2009b) highlights the importance of these meetings to investors. Investors submit non-binding bids for the IPO shares (so-called 'indications of interest') that are used by the underwriters to adjust the IPO's price range.

The bookbuilding process is concluded by the 'effective date', i.e. the date on which the underwriting agreement is executed and on which the shares can first be traded on the exchange. The 'effective date' is set once the financial authority gives its approval for a public listing (Ellis et al., 2000). The underwriters and the company usually settle on the final offer price and the exact number of shares issued on the day before the 'effective date'. The order book that contains the bids from all investors and that is managed by the bookrunner plays a central role in this decision. Once the details are settled, the final prospectus is published, and the underwriter agreement executed. The distribution of shares to the selected investors begins. On the morning of the effective date, the company's shares start trading on the respective exchange for the first time. The pre-IPO owners of the company are usually subject to a 'lock-up period' that prohibits insiders from selling a substantial portion of their shareholdings within a certain timeframe after the IPO, usually comprising 180 days (Lowry et al., 2017).

2.1.4. Post-IPO Phase

Since the responsibilities of an IFA are usually very limited in the post-IPO phase, only a brief description is provided of this stage in the IPO process. Once the company's stock commences trading on the secondary market, an underwriter assumes several responsibilities, most notably price stabilization, market-making, and analyst coverage. For the purpose of price stabilization, an underwriter can, for example, leverage the overallotment option – an option granted to the underwriter by the company that allows to sell up to an additional 15% of shares at offering. In case of stock underperformance after the IPO, an underwriter repurchases the 15% of the stock,

thereby stabilizing the price (Ellis et al., 2000). Moreover, the underwriter can purchase additional shares in the market at or below the offer price to prevent a further price decline (Aggarwal, 2000). While market-making and the provision of liquidity are regarded as crucial responsibilities of underwriters (Brau and Fawcett, 2006), the possibly most important post-IPO service provided by an underwriter is analyst coverage. Cliff and Denis (2004) indicate that companies might even be willing to accept higher underpricing if the underwriter has a so-called 'all-star' (i.e. particularly reputable) analyst coverage team.

2.2. The Underpricing Phenomenon

The term underpricing (also called 'initial returns') describes an IPO anomaly, the persistency of which has intrigued scholars for many decades. Underpricing is defined as the positive relative difference between the closing price of the newly issued shares, usually on the first trading day, and the offer price, i.e. the price at which the IPO shares are sold to the initial investors (Ljungqvist, 2007). If the offer price exceeds the closing price, the term overpricing is applied.

As early as in the late 1960s, Reilly and Hatfield (1969) observed excess returns between 18.3% and 20.2% in a sample of 53 companies going public in the United States. Similarly, Stoll and Curley (1970), Logue (1973) as well as Ibbotson (1975) were among the first to observe positive systematic initial returns. More recent research from Ritter and Welch (2002) corroborates these results of systematic and persistent underpricing over time: in their sample of 6,249 IPOs in the United States between 1980 and 2001, approximately 70 percent of IPOs show a price increase on the first trading day relative to the offer price. The average first-day return in their sample equals 18.8%. While underpricing as a phenomenon has been consistently present independent of the respective period or location, the extent of underpricing varies substantially over time (Loughran and Ritter, 2004) and across countries (Loughran et al., 1994; Boulton et al., 2010). Loughran et al. (2019) report recent data of initial returns for different regions of the world and find pronounced differences across countries.[3] In European countries, the average underpricing for German IPOs between 1978 and 2014 equals 23%, in the United Kingdom 15.8% for the period 1960-2018 and in France 9.7% between 1983 and 2017. Although different across countries and time periods, observed underpricing is substantial. According to Loughran and Ritter (2002), the amount of money 'left on the table' (i.e. additional proceeds that could have been raised) per average IPO is 9.1 million dollars. Ljungqvist (2007) points at 68 billion

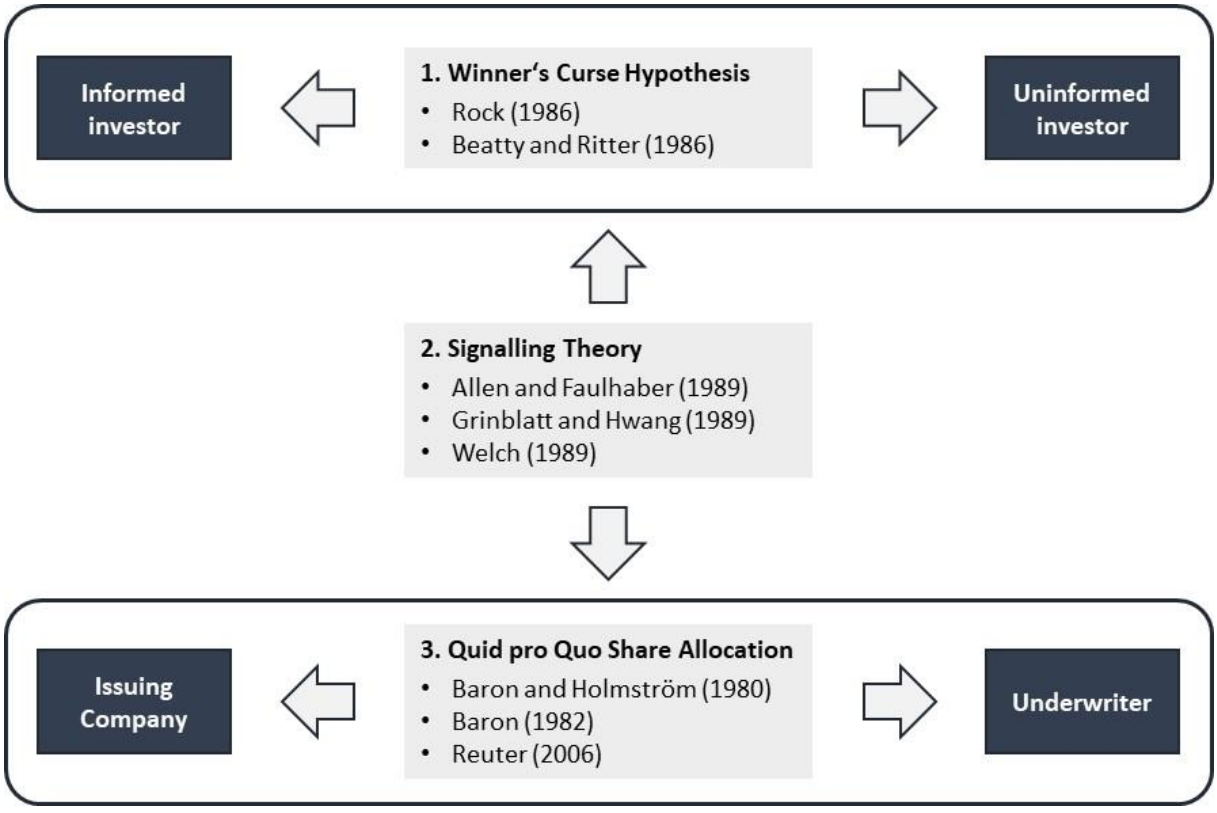
[3] Jay Ritter provides frequent updates on country-specific data of the paper *"Initial Public Offerings: International Insights",* written by Ritter et al. and published in the *Pacific-Basin Finance Journal* in 1994, on his website, which can be accessed via the following link: https://site.warrington.ufl.edu/ritter/ipo-data/ (last access: 09.05.2019).

dollars left on the table in the United States during the years 1999 and 2000. As underpricing represents indirect costs for issuers and pre-IPO shareholders, its large scope motivated a whole field of academic literature attempting to rationalize the phenomenon.

According to Ljungqvist (2007), theories seeking to explain underpricing can be grouped into four main categories: asymmetric information, institutional reasons, control considerations, and behavioral approaches. While the three latter categories pose interesting and partially still nascent explanations for underpricing, they are less relevant within the scope of this thesis. Therefore, this section is centered on theories based on information asymmetries. Up until now, there have been few empirical efforts to measure the relative importance of the different academic strands attempting to explain underpricing (Ritter and Welch, 2002). However, the extensive empirical research and support in favor of theories based on asymmetric information suggest that *"information frictions have a first-order effect […] on underpricing"* (Ljungqvist, 2007, p. 417). The central theories attempting to explain the underpricing phenomenon based on asymmetric information can be divided into three subcategories (Figure 2): (1.) information heterogeneity among investors, (2.) asymmetric information between issuers and investors, and (3.) agency conflicts between underwriters and issuers.

Figure 2: The Potential Types of Information Asymmetry During an IPO Process

The figure below gives an overview about the most common theories of information asymmetry that provide a potential explanation for the underpricing phenomenon. The graphic was designed by the authors of this paper.



2.2.1. Information Heterogeneity Among Investors

Rock (1986) establishes a model that distinguishes between two different types of investors: informed investors and uninformed investors. The former benefit from superior information about the 'true' value (i.e. market value) of the issuing firm and are thus in a better position to evaluate the attractiveness of participating in the IPO. Unlike the uninformed investors, who bid indiscriminately, informed investors only participate in an IPO if it is priced attractively but refrain from participating otherwise. Due to this information asymmetry, uninformed investors suffer from a 'winner's curse' as their demand will be rationed in case of attractively priced IPOs, whereas they receive all shares in unattractive offerings. In Rock's (1986) model, underpricing ensures that the conditional expected return of uninformed investors becomes non-negative. In other words, underpricing ensures that uninformed investors participate in the IPO market. According to the model, underpricing is therefore considered a requirement in the IPO market, assuming that the continued functioning of the IPO market is dependent on the participation of uninformed investors.

One important implication of Rock's (1986) model is that underpricing might be positively correlated with ex-ante uncertainty concerning the IPO (Ljungqvist, 2007). Beatty and Ritter (1986) formalize this idea by evoking a call option analogy. An investor's decision whether to gather information, which is perceived to be costly, is comparable to investing in a call option to buy shares. As option prices, ceteris paribus, increase in value with greater uncertainty, more investors choose to become informed (i.e. invest in the 'option') if uncertainty is higher. In turn, this exacerbates the 'winner's curse' and leads to higher underpricing. For pre-IPO owners, underpricing is associated with involuntary costs, the magnitude of which depends on their fraction of ownership sold in the offering (Habib and Ljungqvist, 2001). Therefore, the issuer has an incentive to mitigate the adverse selection problem by reducing information asymmetry. To achieve this goal, the issuing company can resort to different means as outlined in the next section.

2.2.2. Asymmetric Information Between Issuers and Investors

While Rock's (1986) model implies that informed investors have information superior to that of issuing companies, other theories suggest the opposite: issuers might actually be more informed than outside investors (Allen and Faulhaber, 1989). As companies are likely better informed about their future cash flows and risks, investors fear a 'lemons problem', a concept that has first been introduced by Akerlof (1970). Based on this concept, Allen and Faulhaber (1989), Grinblatt and Hwang (1989) as well as Welch (1989) provide models based on signaling

theories related to underpricing. All these models assume two different types of firms: high-quality firms and low-quality firms. The former use underpricing as a credible signal for quality as they are confident to recoup the costs incurred from deliberately 'leaving money on the table' at a later stage in seasoned equity offerings. In contrast, low-quality firms refrain from mimicking that signal as they face a risk of detection, which limits their expected recuperation in subsequent equity issuances. While these models all rely on underpricing as a credible signal for quality, other scholars have focused on different and less costly positive signals, such as the reputation of underwriters (Booth and Smith, 1986; Carter and Manaster, 1990), the quality of auditors (Titman and Trueman, 1986), or the reputation of Venture Capital investors as pre-IPO shareholders (Megginson and Weiss, 1991; Lee and Wahal, 2004).

The overall empirical evidence of these models based on the signaling theory appears to be mixed. Consistent with the signaling theory, Jegadeesh et al. (1993) find a positive correlation between IPO underpricing and the likelihood and size of subsequent seasoned offerings, using data on public offerings between 1980 and 1986. By contrast, Michaely and Shaw (1994) find evidence that seems to be inconsistent with the signaling theory. In their sample of IPOs between 1984 and 1988, firms that experienced higher underpricing participated less frequently in subsequent issuances and with lower proceeds raised.

Another important theory that seeks to explain the underpricing phenomenon based on the information asymmetry between issuers and investors is the 'information revelation hypothesis'. Benveniste and Spindt (1989), Benveniste and Wilhelm (1990), and Spatt and Srivastava (1991) refer to bookbuilding as a mechanism to overcome this information asymmetry. As described in Section 2.1.3, underwriters use the bookbuilding process to gather information from informed investors about their willingness to pay for the company's shares. However, investors have an incentive to understate their interest in the company's shares, so as to achieve a lower offer price. In order to incentivize investors to reveal their information, bookrunners have to reward them with a favorable allocation of shares, i.e. a proportionally larger share allocation in underpriced IPOs. Benveniste and Spindt (1989) emphasize that the 'repeated game nature' of the interaction between investment banks and investors in the IPO market gives investment banks leverage in the process: To ensure their future participation in lucrative IPOs, investors might be willing to accept a lower average level of underpricing and might even be willing to participate in poorly performing IPOs.

Hanley (1993) documents empirical evidence for one of the important implications derived from Benveniste and Spindt's (1989) model, the 'partial adjustment' phenomenon. This

phenomenon refers to the fact that underwriters only partially adjust their original share price published in the preliminary prospectus if they face strong demand because they need to leave some 'money on the table' to reward investors for their information revelation. Other evidence in favor of the information revelation hypothesis is provided by Cornelli and Goldreich (2001; 2003), who compare different bidding practices from investors and the resulting allocation of shares.[4] Given that step-bids reveal more information than price-limited bids, this would suggest that such bids are rewarded accordingly. Consistent with this hypothesis, Cornelli and Goldreich (2001) find such a preferential allocation for investors submitting price-limited bids. Moreover, Cornelli and Goldreich (2003) show that such price-limited bids are incorporated in the pricing of the IPO by underwriters. However, evidence on this hypothesis is generally mixed. Investors surveyed by Jenkinson and Jones (2009b), for example, appear to have a different view. They do not consider the type of bid submitted to be a decisive factor of share allocation. Instead, they perceive other factors to be of greater importance: the existing brokerage business with the underwriter, being a long-term investor, being a frequent subscriber to IPOs, and being a large investor. These survey results are statistically supported by Jenkinson and Jones (2004), who find that being considered a long-term investor is significantly more important than the type of bid submitted when share allocations are determined.

The theories of bookbuilding emphasize the importance of the underwriter syndicate to overcome the information gap between issuers and investors and stress the potential benefit of giving investment banks discretion over allocation decisions (Ljungqvist, 2007). On the other hand, the reliance on bookbuilding gives rise to a potential conflict of interest between investment banks and the issuing company. Principal-agent models, which examine the information asymmetry between investment banks and issuing companies that results from bookbuilding, are discussed in the next section.

2.2.3. Agency Conflict Between Issuers and Underwriters

An agency problem arises when underwriters use their informational advantage not in the best interest of the issuing company. Given their responsibility for and discretion over the allocation of shares, underwriters might use their informational advantage obtained from the bookbuilding process to allocate shares in service of their self-interest. For a company going public, a

[4] Cornelli and Goldreich (2001, 2003) distinguish between three types of bids: 'strike-', 'limit-', and 'step-bids'. A 'strike-bid' simply specifies a requested number of shares regardless of the issue price, whereas 'limit-' and 'step-bids' disclose more information, as they include price sensitivities. In a 'limit-bid' an investor reveals the maximum price he/she is willing to pay for the shares and in a 'step bid', the investor submits a demand schedule as a step function.

desirable investor is a long-term investor that will not engage in so-called *flipping*, i.e. the immediate selling of shares after the IPO (Aggarwal, 2003). Investment banks argue that their institutional clients are most suited as long-term shareholders. However, Aggarwal (2003) provide evidence that in fact institutional rather than retail investors are responsible for the majority of flipping. In addition, Chemmanur et al. (2010) show that such investors are not generally penalized through less favorable allocations in future IPOs for flipping shares. Consequently, the fact that institutional investors receive a large fraction of issued shares might not always be aligned with the best interest of the issuing company.

Several studies have focused on the proportions of IPO shares allocated to institutional versus retail investors, respectively. Investigating 38 U.S. IPOs conducted between 1983 and 1988, Hanley and William (1995) observe that approximately 70% of the shares were allocated to institutional investors. Aggarwal et al. (2002) identify a very similar pattern in their sample of 164 U.S. offerings between 1997 and 1998.

Baron and Holmström (1980) and Baron (1982) provide early models investigating the information asymmetry between underwriters and issuers. In these models, issuing firms appoint investment banks to gain access to investment banks' superior information about market demand. However, the lack of observability of investment banks' effort in the IPO process gives rise to a moral hazard problem: Investment banks have an incentive to use the gathered information in their own interest to minimize their marketing and distribution efforts. In Baron's (1982) model, issuers are able to raise higher proceeds when hiring an underwriter, so that it remains optimal to do so despite the issue of moral hazard. Appointing investment banks to execute a bookbuilt IPO, companies must give banks discretion over the share pricing decision. Banks leverage their private information and discretion to choose a high spread contract and low offering price if they expect demand to be low, and vice versa if they consider demand to be high. Thus, the best reachable solution with an incentive-compatible contract involves agency costs in the form of underpricing.

While the latter models center on investment banks' optimal pricing and allocation behavior to maximize their compensation during a specific IPO, other studies have pointed at investment bank's relationships with favored buy-side clients and the 'repeated game nature' of IPOs

(Lowry et al., 2017). In other words, these theories suggest that investment banks allocate their shares on a 'quid pro quo' basis (Pulliam and Smith, 2001; SEC news release 2002-14).[5]

Several studies find convincing evidence for share allocations based on such a 'quid pro quo' principle. Reuter (2006) observes a robust, positive correlation between commissions paid by mutual fund families to lead underwriters and the respective fund's holdings of newly issued shares underwritten by the same investment bank. Since he finds this relation to be limited to IPOs with nonnegative first-day returns, it provides important evidence that direct relationships to investment banks increase investors access to IPOs with positive initial returns. Hence, banks seem to reward investors with lucrative IPO allocations in exchange for benefits such as commission payments. Goldstein et al. (2011) confirm Reuter's results of a direct (positive) link between the commissions paid by investors and their received allocation of underpriced shares. In a similar vein, Jenkinson et al. (2018) establish a quartile ranking of investors in their sample according to the revenue each of the investors generate for the bookrunner of an IPO to estimate the extent of business relations between investors and banks. Subsequently, they test the interrelation between investors' economic relationships with underwriters and their received proportion of shares in underpriced IPOs. In line with the principle of 'quid pro quo', they find that the fraction of shares allocated increases across investor-revenue quartiles.

As a final note, the theories stated above are not mutually exclusive. For instance, underwriters may favor both investors who provide informative bids (revelation hypothesis) and those with whom they conduct the majority of their profitable business ('quid pro quo').

2.3. The Independent Financial Advisor

The role of IFAs in the IPO process has only started to gain traction in the aftermath of the Global Financial Crisis. In consequence, academic research and literature on the topic are fairly scarce, which is why the following section relies primarily on expert interviews with financial experts conducted by the authors of the thesis, as well as on the paper of Jenkinson et al. (2018). First, this section gives a definition of IFAs. Second, it describes the role and responsibilities of IFAs in the IPO process. Finally, it explains how IFAs relate to the agency conflict between underwriters and companies, and how they might be able to impact underpricing.

[5] The Securities and Exchange Commission (SEC) filed charges of 100 million dollars against the Credit Suisse First Boston Corporation (CSFB) for *"practices relating to the allocation of stock in "hot" initial public offerings (IPOs)."* CSFB used its position as underwriter to allocate shares of hot IPOs to customers who returned some of their IPO profits to CSFB through excessive commissions.

2.3.1. Definition

For the purpose of this thesis, an IFA is defined as a company that exclusively offers financial advisory services. These services usually encompass mergers and acquisitions advisory, debt capital market advisory, and equity capital advisory including IPOs. The word 'exclusively' is crucial, as it defines what separates an IFA from traditional investment banks: (i) IFAs do not underwrite IPOs, nor do they offer post-IPO services such as price stabilization or analyst coverage. As a result, companies still need to employ an investment bank which executes the actual underwriting, and which provides post-IPO services. (ii) IFAs do not have a sales and trading business, and thus not the same type of relationship with institutional clients that constitutes a vital revenue stream for investment banks.

It is also noteworthy that the terminology used to refer to IFAs is not consistent throughout news articles, IPO prospectus, and even not among IFAs themselves. Other frequently used terms include 'financial advisor', 'IPO advisor', 'corporate finance advisor', or 'independent advisor', but they describe the same type of company and services provided. To properly define an IFA, it is also crucial to clearly distinguish the role of IFAs from other advisors involved in the IPO process. Within the scope of this paper, the term IFA does not entail management consulting companies, nor accounting firms providing due diligence support in the IPO process. Similarly, so-called 'Nominated Advisers' that are a mandatory requirement for listings on the *London Alternative Investment Market (London AIM)* – the unregulated part of the *London Stock Exchange (LSE)* - are not considered IFAs. The principal reason behind this decision is that the role of 'Nominated Adviser' is closer to that of a 'traditional' bookrunner as to that of an IFA. Since several financial advisory companies operate both as IFAs and 'Nominated Advisers', it is important to emphasize that the criterion applied to ensure a clear distinction between the two is the respective role that the financial advisory company assumes in an individual IPO.[6] The *Euronext* exchange has a similar, unregulated segment called *Euronext Growth* (formerly known as *Alternext*). Listing at the *Euronext Growth* also mandates the appointment of an advisor similar to that of a 'Nominated Adviser' called a 'Listing Sponsor'. However, and contrary to the role of a 'Nominated Adviser', the role of a 'Listing Sponsors' is supplementary to that of the underwriter, meaning that a listing at the *Euronext Growth* still requires an investment bank to take on the role of bookrunner. Therefore, 'Listing Sponsors' are considered IFAs for the purpose of this thesis.

[6] Since several accounting firms that were traditionally only involved in the due diligence have started to offer their services in the role of an IFA as well, the same role-based distinction as for 'Nominated Advisers' is applied.

2.3.2. Function in the IPO Process

It is important to note that IFAs are not a homogeneous group. For instance, they vary significantly in size. In turn, their size and the associated resources available have an impact on the scope of responsibilities that IFAs can assume. Large IFAs, which work on an international scale with several offices in different regions, such as *Lazard* or *Rothschild & Co*, structure their IPO teams similar to those of investment banks by combining regional, sectoral and product experts. They also take on responsibilities traditionally held by the global coordinator and lead manager. Such responsibilities include, inter alia, selecting additional advisors and coordinating between syndicate members. By contrast, 'boutique advisories' with fewer resources at their disposal focus mostly on the functions that investment banks themselves cannot perform, as for example advising companies on the selection of the underwriter syndicate.

Regardless of their size, most IFAs usually get involved in the IPO process earlier than investment banks do. IFAs' mandate frequently starts with advising the company on whether to pursue a public listing at all and which exchange(s) to target. Depending on how experienced owners and executives of a company are, IFAs might spend considerable resources on educating them about the IPO process in general. IFAs are usually engaged in the selection of the underwriter syndicate by analyzing factors such as reputation, sector expertise, and proposed valuation of the issuing company. Once the underwriter syndicate is selected, IFAs often support firms in negotiating investment banks' fee structure.

During the pre-marketing phase, IFAs frequently assume the lead managers' responsibility of selecting additional advisors that are necessary to carry out the due diligence (e.g. the legal advisors). Throughout the process, IFAs also consult their own network of institutional investors and generally strive to *"ensure to give full visibility to the company on the market place"* (Agnew and Massoudi, 2014, paragraph 7). Depending on the resources available, an IFA might have a significant impact on shaping the company's 'equity story' and rely on its own valuation models. However, IFAs generally do not participate in writing the preliminary prospectus, which is done by the underwriter syndicate and legal advisors. During the bookbuilding phase, IFAs often participate in the road show and are usually highly involved in determining both the final offer price and the share allocation to investors.

Once the IPO is completed, IFAs are not heavily engaged in the process anymore, with the exception of advising the company on how to allocate the investment banks' discretionary fees. The extent to which IFAs interact with investment banks and coordinate the IPO process again depends on their resources. Large IFAs often assume most of the coordination, which is

otherwise carried out by the lead manager or global coordinator. In such cases, they become essentially an intermediary between the issuer and the underwriter syndicate. The investment banks then have to channel most of their communication through the IFA. It is precisely this circumstance that investment banks use to exemplify why IFAs could add another layer of complexity to the IPO process – potentially without adding sufficient value to compensate for it.[7]

Finally, the compensation structure of IFAs comprises usually two components, a base fee and a discretionary fee (Jenkinson et al. 2018). The base fee is either defined as a percentage of the proceeds raised in the IPO or a fixed retainer. The discretionary fee is paid in addition to the base fee to reward IFAs for a successful execution of the IPO. It is based on the evaluation carried out by the issuing company and the pre-IPO owners.

2.3.3. Potential Impact on Underpricing

As outlined in the previous section, the distinctive feature of IFAs is that they do not underwrite share issues, nor do they offer trading and sales services. The latter is critical as it ensures that, contrary to a traditional investment bank, IFAs do not have the same conflicts of interests with issuing companies. Moreover, the compensation structure aligns IFAs' interests with those of the issuing company (Burgess, 2014). Thus, representing the company's best interests and supporting them throughout the whole IPO process with their expertise, IFAs could have the potential to resolve, or at least mitigate the conflict of interests between issuing companies and investment banks. In awareness of this unique selling point, IFAs usually refer to this mitigating influence when marketing their services to issuing companies (Masters, 2014). In a similar vein, the expert interviews conducted by the authors suggest that the mere presence of an IFA might change banks' behavior in the IPO process. While there is almost no prior empirical research that tests theories related to IFAs and underpricing, Jenkinson et al. (2018) observe slightly lower mean and median first week returns for IPOs which involved an IFA compared to IPOs that did not. Their sample consists of 220 IPOs conducted in the UK between 2010 and 2015. How IFAs specifically mitigate the information asymmetry between issuers and underwriters, how this potentially reduces the extent of underpricing in an IPO, and through which channels IFAs potentially exert their influence, is discussed in the remainder of this section. This is done by relating the theories of underpricing as illustrated in Section 2.2 to the role of IFAs in the IPO process as outlined above.

[7] Given the obvious self-interest of investment banks to operate without the presence of an IFA, such an assessment can certainly not be taken at face value.

First, an IFA may be able to reduce the information asymmetry and ensuing agency conflict between issuers and investment banks at different stages of the IPO process. At the very early stage of the IPO process, IFAs might do so by advising the issuer on the selection of the underwriter syndicate. As noted by Jenkinson and Jones (2009a), investment banks have a high incentive to engage in what they label 'bait and switch'. This means that investment banks have an incentive to propose high valuations of the company's shares during their pitch in order to win the mandate, only to then adjust their valuation downward later in the process when their bargaining power has increased. They are able to rely on this 'bait and switch' strategy by taking advantage of timing: As switching the underwriter is associated with continuously increasing costs the closer the 'effective date' comes, the company has very limited power to defy the investment banks late in the process. IFAs can mitigate this problem by challenging investment banks' proposed valuations from the beginning, i.e. by mitigating information asymmetry between the issuing company and the investment banks at an early stage in the IPO process. Similarly, IFAs can provide a second and possibly more objective opinion on the final offer price, thus decreasing possible underpricing at the end of the process.

Second, IFAs potentially mitigate the moral hazard problem of investment banks that Baron (1982) refers to in his model (Section 2.2.2). Jenkinson et al. (2018) show that the share of discretionary fees of underwriters' total fees (measured by the median) is approximately twice as large for IPOs that have an IFA. Advising the company on the underwriters' fee structure, IFAs seem to contribute to a compensation structure that is more performance-oriented, and thus more aligned to the issuer's interests. In consequence, the agency conflict between the issuer and underwriters is mitigated, which again is likely to reduce underpricing.

Finally, IFAs may alleviate the potential conflict of interest between the issuing company and investment banks inherent to the allocation of shares (Jenkinson et al., 2018). The survey conducted by Brau and Fawcett (2006) emphasizes how important CFOs deem this potential agency conflict: 42% of CFO respondents regard the agency conflict, i.e. investment banks seeking to reward favored institutional clients in IPOs, as an important source of underpricing. Thus, one of the main motives for issuing companies to engage an IFA is the optimization of their investor base via the inclusion of reputable, long-term holders, and to prevent investment banks from preferential treatment of institutional clients important to their sales and trading business (Agnew and Massoudi, 2014). To put it differently, *"because they work for the issuer, it is reasonable to expect that the advisors can monitor the underwriter's behavior and ensure that there are no quid pro quos during allocation"* (Hanley, 2017, p. 21). Once IFAs have more

control over the share allocation, investment banks' incentive to underprice shares decreases considerably, as they have less opportunity to reward their own clients.

Apart from these channels that all rely on IFAs' potential mitigating impact on the agency conflict between issuing firms and investment banks, IFAs role can also be examined in the context of other theories seeking to explain underpricing: Appointing an IFA may help to mitigate the information asymmetry between issuing companies and investors (i.e. signaling theory). First, IFAs can support the company in finding the underwriter with the best reputation, or the investment bank that is most capable of achieving the best IPO results based on objective criteria. Experts interviewed for this thesis highlighted the importance of advising the issuer on the selection of the underwriter based on criteria such as their expertise in the issuing firm's industry, their analyst coverage, current capacity, recent IPO results, fee structure etc. They also emphasized the objectivity they can bring into a process in which companies might otherwise be tempted to simply choose the bank that they have the longest established relationship with. Hiring a high-quality and competent underwriter may be interpreted by the market as a positive signal. As a result, investors' own need to gather information may be reduced, mitigating the winner's curse (Ljungqvist, 2007). Lastly, appointing a prestigious IFA could itself be a positive signal to the market.

In conclusion, there appear to be several channels through which the participation of an IFA in the IPO process might have an effect on underpricing. While all of these channels are based on the theory of information asymmetry, a distinction can be made: Some channels are based on the information asymmetry between the issuing company and the underwriter syndicate, resulting in an agency conflict. Other channels are related to the notion of the signaling theory and thus based on the information asymmetry between the issuing company and its potential investors. Having studied these theoretical channels through which IFAs potentially affect underpricing, the next section lays out the hypotheses that form the basis for the subsequent empirical analysis.

3. Research Questions and Hypotheses

As described in Section 2.2 above, underpricing is a persistent phenomenon in the IPO process. It can constitute a considerable cost and potential deterrence for companies that consider going public. Section 2.3 above expounds how IFAs might mitigate this problem of underpricing in the IPO process by (i) reducing information asymmetry and the ensuing conflict of interest between issuing companies and investment banks, and/or by (ii) decreasing the ex-ante uncertainty that potential investors face when valuing the company. Thus, the following research question can be formulated:

> *"Does the involvement of an IFA in the IPO process lead to a beneficial effect on IPO pricing for companies going public?"*

In order to approach this first research question, it is a prerequisite to establish the existence of underpricing in the examined sample. Due to the persistence of underpricing across different periods and geographies (Loughran et al., 2019), the presence of underpricing is also expected in the sample of this paper. Hence, the following hypothesis is stated:

H1: Underpricing does exist in the selected final sample of IPOs.

If **H1** is confirmed, in a next step, it can be analyzed if IFAs provide a benefit to issuing companies by reducing the existing underpricing and thus involuntary costs of going public:

H2: The involvement of an IFA in the IPO process mitigates underpricing.

In addition to this important effect that an IFA might have on the IPO process, there is a second potential effect that warrants further analysis. As argued by Beatty and Ritter (1986), the level of ex-ante uncertainty in the IPO process should not only affect the expected magnitude of underpricing in a sample, but also the dispersion of underpricing across IPOs. Thus, if the sample includes subsamples of IPOs that exhibit differences in the extent of ex-ante uncertainty, the sample is likely to be heteroscedastic, i.e. it contains subsamples that show different magnitudes of variation with respect to the level of underpricing. Consequently, if IFAs reduce ex-ante uncertainty, the group of IPOs in the sample that did involve an IFA should exhibit a lower dispersion (i.e. variation) in underpricing than the group that did not. In other words, companies that engage an IFA should not only benefit from lower average underpricing but also from a higher expected offer price accuracy:

H3: The involvement of an IFA in the IPO process improves the accuracy of the offer price.

Under the assumption that both **H2** and **H3** are supported, it can be inferred that hiring an IFA has beneficial effects on the offer price in an IPO process. In turn, this raises a second important research question that is investigated in order to find out which companies rely on these potential benefits:

> *"Do companies that appoint an IFA differ in their firm-specific characteristics from companies that do not engage an IFA?"*

Given the lack of prior research on this topic, the hypotheses related to the second research question are mostly based on the expert interviews conducted, as well as on the authors' own inferences from IPO literature. In the interviews, two characteristics were emphasized regarding the second research question: First, experts argued that an issuing company's size should be positively correlated with the likelihood of engaging an IFA. The principal reason for this relation is the cost associated with appointing an IFA. The relative cost of engaging an IFA compared to the overall costs of conducting an IPO are particularly low for large IPOs. While this is obvious in the case of a fixed IFA fee, it is most likely also applicable for a variable fee structure defined as a percentage of proceeds raised. Comparable to the fee structures of investment banks, this percentage number likely decreases with the size of the IPO. For instance, the IFA might receive 2% of proceeds raised in a small IPO, but only 0.5% in a large IPO. Moreover, IFAs may have a defined minimum fee for their services below which a mandate is not financially lucrative, regardless of the size of the IPO. Vice versa, it might then be economically unfeasible for issuing companies below a certain size to engage an IFA.[8] Hence, the following hypothesis is formulated:

H4a: Large companies going public are more likely to appoint an IFA.

The second characteristic highlighted in the expert interviews is the pre-IPO ownership structure of the issuing company. It appears that the level of financial sophistication of the owners might have a significant impact. Private Equity (PE) and VC investors are frequently involved in the IPO process since IPOs represent one common exit strategy for their investments. Hence, it is reasonable to assume that they have a higher-level of expertise related to the IPO process than an owner taking a company public for the first and most likely only time (e.g. when ownership lies with the original founder). Based on this assumption, two opposing inferences could be derived. On the one hand, it could be argued that owners with a higher level of financial

[8] This is dependent on the assumption that the larger the company, the larger is the average IPO size (transaction volume). The relationship has been tested and is found to be significant and approximately 60% for the sample.

sophistication are more likely to appoint an IFA as they are more aware of the complexities and conflicts that an IPO entails. Thus, they are better able to appreciate the benefits that an IFA provides. Less sophisticated owners by contrast might perceive IFAs as an avoidable extra cost as they do not have the expertise to recognize the benefits provided. On the other hand, it could be argued that the benefits of engaging an IFA diminish as the expertise of the pre-IPO owners themselves increases. Consequently, an IFA might not be able to provide particularly valuable services or insights to an owner who has been through the IPO process numerous times compared to an owner that takes a company public for the first time. Given these two opposing arguments, the exact nature of the relationship between ownership structure and the appointment of an IFA seems ambiguous. The following hypotheses are stated:

H4b: The presence of a PE investor as pre-IPO shareholder affects the likelihood of the issuing company to appoint an IFA.
H4c: The presence of a VC investor as pre-IPO shareholder affects the likelihood of the issuing company to appoint an IFA.

These hypotheses are successively tested in Section 5. Prior to this, Section 4 introduces the sample and methodology used to test these hypotheses.

4. Data and Methodology

This section describes the sample and research design applied to test the hypotheses stated in the previous section. It starts by explaining the data generation process and by introducing the variables used within the scope of this paper. Thereafter, Section 4.4 establishes the research methodology implemented.

4.1. Data Collection

The thesis is based on IPO data retrieved from the *Thomson Reuters Securities Data Company Platinum* (*SDC Platinum*) database, on which most academic IPO research relies (Lowry et al., 2017). The initial sample selection was restricted to IPOs in Western Europe during the period from 01.01.2010 to 20.02.2019. This decision was made based on the expert interviews conducted and on Jenkinson et al. (2018). As noted by Jenkinson et al. (2018), the role of IFAs in IPOs is comparatively novel and was established in most countries during the last decade. Furthermore, Western European IPOs were chosen as the reliance on IFAs is more widespread in this region than in other developed capital markets, such as the United States. As noted by Schuster (2003), IPOs within Europe share similar IPO characteristics, so that European IPO markets seem sufficiently comparable among each other for the purpose of this paper. The derivation of the final sample is illustrated in Table 1 below.

Table 1: Sample Derivation

The table displays the detailed process of the sample construction. The initial sample of 1,876 Western European IPOs between January 2010 and February 2019 is obtained from the SDC Platinum database.

Initial Sample of Western European IPOs from 01.01.2010 to 20.02.2019	**1,876**
Excluding the years 2010 and 2011	-371
	1,505
Excluding Real Estate Investment Trusts (REITs) and investment funds[9]	-183
	1,322
Restricting the IPO size to ≥ 10€m	-364
	958
Removing observations with missing information on underpricing	-431
	527
Removing observations with missing information on Private Equity backing	-44
	483
Multiple tranches merged	-51
	432
Outliers removed	-8
	424
Inconsistency in data between database and own research	-8
	416
Prospectus not found	-43
Final Sample	**373**

[9]143 of these 183 observations were removed by using the industry classification provided by *SDC Platinum*, whereas 40 were identified as REITs or investment funds after inspecting the companies' prospectus or website.

Starting with an initial sample of 1,876 IPOs in Western Europe, IPOs from the years 2010 and 2011 were excluded due to a lack of availability of certain information, such as IPO prospectus for a majority of observations. Following common procedures in academic literature (e.g. Hu and Ritter, 2007), all IPOs related to Real Estate Investment Trusts (REITs), investment funds, and offerings including warrants such as unit trusts were removed from the sample. Moreover, IPOs with total proceeds raised below 10 million euros were excluded from the sample. As a next step, IPOs with missing data on underpricing and/or PE ownership were excluded.[10] Some IPOs are split into multiple tranches in the *SDC Platinum* database when an offering is not only marketed at the primary but also at other exchanges. All such multiple tranches were consolidated so as to not include any IPO more than once. Eight outliers were excluded to avoid a distortion of the analysis.[11] Finally, 43 observations were disregarded since no IPO prospectus was found, resulting in a final sample of 373 observations.

The information whether an IFA participated in the respective IPO process was manually collected. To ensure the reliability of the sample regarding this information, the thesis relied on three different sources/approaches: (i) The *SDC Platinum* database that lists IFAs under the category 'Issue Advisors', (ii) the IPO prospectus of the respective issuer, and (iii) a manual search on the internet. When deciding whether a specific party involved in an IPO can be considered an IFA, the choice was made based on the definition laid out in Section 2.3.1. In consequence, 'Nominated Advisers' for IPOs at the *London AIM* are not classified as IFAs, whereas 'Listing Sponsors' are classified as such.

There are several reasons that provide confidence in the reliability of this data collection method: First, the experts interviewed from independent financial advisories have emphasized that visibility is important for them. It is in their self-interest to have their involvement in IPOs published since their track record is vital to generate future business. Thus, IFAs generally want to be visible in transactions and prefer to be named in the IPO prospectus.[12] Moreover, there seems to be no reason, why the issuing company or investment banks should refrain from mentioning the involvement of an IFA in the IPO process since it might provide a positive signal (as described in Section 2.3.3). However, as the underwriting syndicate is ultimately in charge

[10] While both *Thomson Reuters Eikon* and *Yahoo Finance* were considered as potential sources to fill up the missing data, both ultimately could not be used to complement the missing information.
[11] The cut-off for removal were first day initial returns above +90 and below -85%.
[12] The process to search for IFAs within the IPO prospectus was standardized by using the same search terms, 'adviser' and 'advisor' for all prospectus. When the search was successful, the role of the respective company was analyzed to ensure that it was in fact an IFA and not a different kind of advisor, such as a legal advisor.

of creating the prospectus, it might decide to leave the IFA's name off the prospectus. In such a case, it can be expected that the IFA is named in press releases related to the IPO or publishes its participation in the IPO on its own website. To account for this circumstance, a manual search on the internet was conducted.[13] Second, the share of IPOs that involved an IFA in the sample is approximately one-third, which is very much in line with the share in the sample of Jenkinson et al. (2018). Third, the IPOs listed by *SDC Platinum* which included an IFA were all searched manually on the internet as a cross-check, and the involvement of an IFA could be confirmed for all of them.

For certain variables used in the subsequent analysis, *SDC Platinum* does not contain sufficient information. This data was collected manually from the respective IPO prospectus. The variables concerned are the issuing company's revenues of the last twelve months prior to the IPO, the company's total assets, total liabilities, and long-term debt, all taken from the most recent date prior to the IPO. The company's age at the time of the IPO was also extracted from the IPO prospectus. Given the high level of standardization of IPO prospectus within the European Union (as noted by Gajewski and Gresse, 2006), this information is available for all companies in the sample.

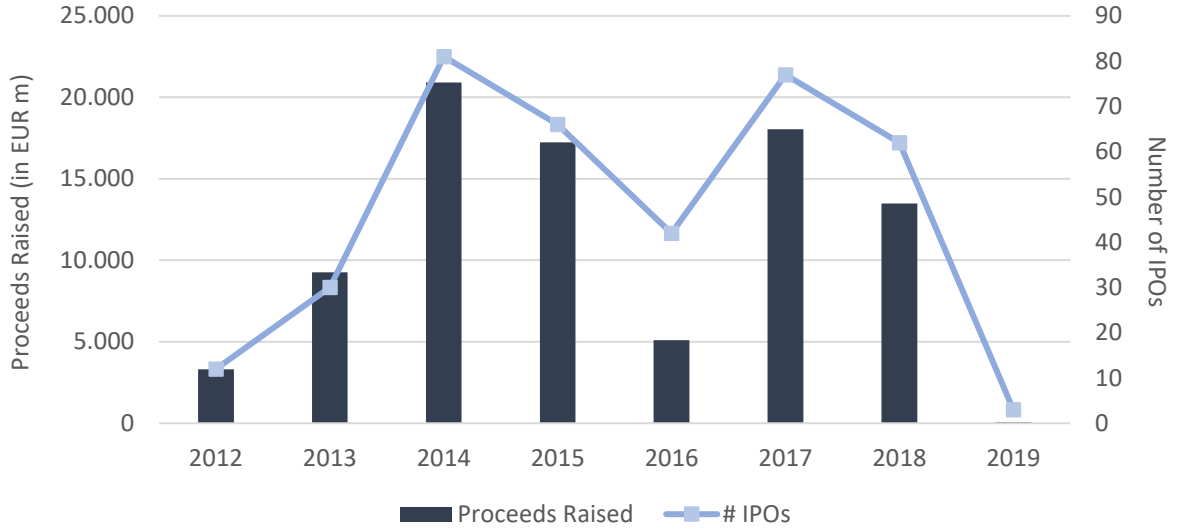
4.2. Sample Description

This section is intended to provide a concise and comprehensive overview of the data used in the subsequent models for the purpose of testing the hypotheses stated in Section 3. The final sample consists of 373 Western European IPOs from the period January 2012 to February 2019. Approximately one third of these IPOs involved an IFA. The total amount of capital raised for the entire sample was 87,414 million euros with a median IPO value of 69 million euros. As observable from Figure 3 on the next page, both the total capital and median amount of proceeds raised differ across the sample period. Given that observations had to be excluded from the final sample due to insufficient data, the number of IPOs and proceeds raised for the respective years might not be representative of the overall Western European IPO market at the time. Hence, no inference about cyclicality of the overall Western European IPO market should be made based on the sample data presented. Concerning the share of IPOs which involved an IFA, no substantial difference across the included years is observed.

[13] The search terms used in combination with each company's name were 'IPO adviser', 'IPO advisor', 'independent adviser', 'independent advisor', 'financial adviser', 'financial advisor'. Additionally, press releases related to the company's IPO were checked, as well as publicly available transaction databases from IFAs such as Lazard.

Figure 3: Distribution of the Number of IPOs and Proceeds Raised by Year

The graph and table below report the sample's proceeds raised in million euros of all IPOs in the final sample, and the number of IPOs per year. The sample consists of 373 Western European IPOs with total proceeds raised of approximately 87,412 million euros. The table also shows the number of IPOs that involved an IFA.



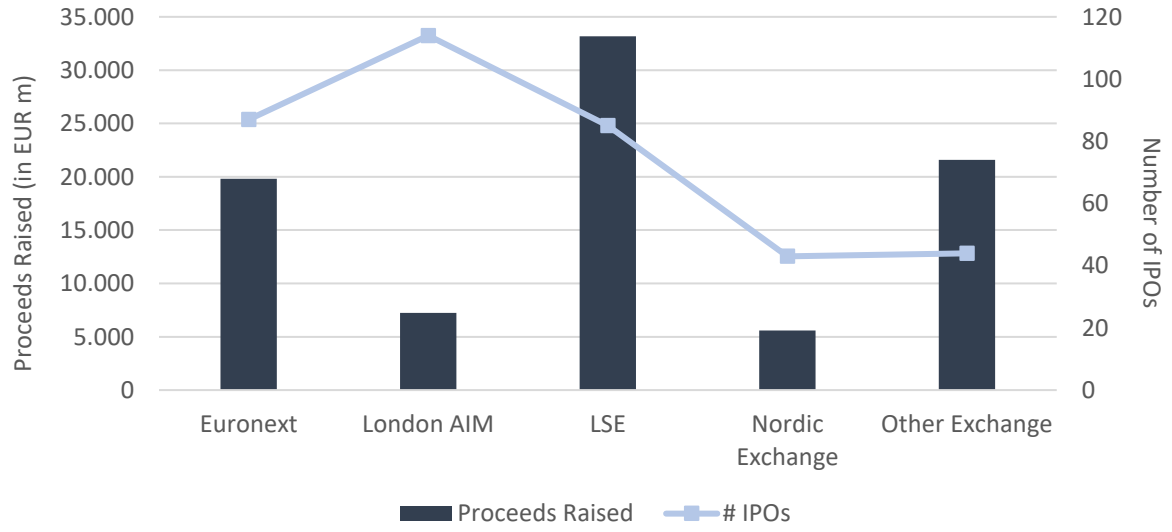
Year IPO	Median Size (in EUR m)	Proceeds Raised (in EUR m)	# IPOs	# IPOs with IFA	% IPOs with IFA
2012	129	3,306	12	3	0.25
2013	66	9,267	30	13	0.43
2014	105	20,902	81	33	0.41
2015	94	17,236	66	19	0.29
2016	35	5,098	42	15	0.36
2017	60	18,047	77	24	0.31
2018	63	13,494	62	19	0.31
2019	20	61	3	0	0.00
Total	**69**	**87,412**	**373**	**126**	**0.34**

The sample can also be sorted by exchange (cluster) as illustrated in Figure 4 on the next page. The cross-country stock exchange *Euronext* comprises all stock exchanges of the countries Belgium, France, the Netherlands, and Portugal that are related to the *Euronext Group*. The cluster *Nordic Exchange* includes the stock exchanges of Denmark, Finland, Norway, and Sweden. *Other Exchange* contains all other listings, including exchanges in countries such as Germany, Italy, and Switzerland. The most active markets in the sample measured by total number of IPOs are the *London AIM* (~31%) followed by the *LSE* and *Euronext* (each ~23%). However, based on proceeds raised, *London AIM* constitutes only 8% of the overall sample, whereas the *LSE* accounts for the largest part with a share of approximately 38%. These differences in proportions by number of IPOs and proceeds raised are explained by exchange-specific

characteristics. Due to differences in regulation, *London AIM* is conceived for smaller and mid-cap, growth-oriented firms, whereas the *LSE* attracts larger and more mature firms (Mendoza, 2008). The share of IPOs that involved an IFA seems to differ substantially across different stock exchanges. While the fraction of IPOs including an IFA is only 9% at the *London AIM*, more than half of the IPOs at the *LSE* and *Other Exchange* involved the participation of an IFA. One important reason for the scarce presence of IFAs in listings at the *London AIM* could be the role of the 'Nominated Adviser' as highlighted in Section 2.3.1, as well as the companies' size difference.

Figure 4: Distribution of the Number of IPOs and Proceeds Raised by Exchange

The graph and table below report the proceeds raised in million euros of all IPOs in the final sample, the total number of IPOs in the final sample, and number/ share of IPOs including an IFA by exchange. The cluster 'Other Exchange' comprises, inter alia, the Borsa Italiana, Frankfurt Stock Exchange, and SIX Swiss Exchange. 'Nordic Exchange' comprises, inter alia, the OMX Helsinki, OMX Stockholm, and Oslo Stock Exchange. For a detailed list of all IPOs and their respective exchanges refer to Table 14 in Appendix G.



Exchange	Median Size (in EUR m)	Proceeds Raised (in EUR m)	# IPOs	# IPOs with IFA	% IPOs with IFA
Euronext	35	19,811	87	36	0.41
London AIM	37	7,228	114	10	0.09
LSE	271	33,181	85	47	0.55
Nordic Exchange	54	5,589	43	8	0.19
Other Exchange	171	21,603	44	25	0.57
Total	**69**	**87,412**	**373**	**126**	**0.34**

Finally, the sample's IPOs can be sorted by the issuing companies' industry classification. In line with the classifications used in Davidson et al. (2006), 108 (~29%) IPO firms were

categorized as belonging to the technological industry, 66 firms (~18%) as belonging to the financial industry, and three firms (~1%) as belonging to the utilities industry. For a more detailed classification including other industry categories refer to Table 7 in Appendix A.

4.3. Variable Description

In concurrence with previous literature, underpricing *(UP*) is defined as the percentage difference between the historical closing price on the first day of trading P_{close} and the offer price P_{offer} (Daily et al., 2003, Ljungqvist, 2007):

$$UP = \frac{P_{close} - P_{offer}}{P_{offer}} * 100\% \quad (1)$$

In other words, underpricing is specified as P_{close} exceeding P_{offer}, resulting in a positive first day return. When P_{close} is identical to P_{offer}, no underpricing occurs as the company's shares were issued at a price equal to the market's expectations ('true' value). Finally, if P_{close} is below P_{offer}, i.e. the first day return is negative, the shares are considered to be overpriced.

The variable *IFA* is defined as a binary variable that equals 1 for any IPO in the sample that involved an IFA and 0 otherwise. *IFA* was set equal to 1 whenever the definition of an IFA laid out in Section 2.3.1 was met. Following the hypothesis in Section 3, it is expected that the presence of an IFA will have a mitigating effect on the underpricing of a company's shares (i.e. a significant, negative coefficient in the regression model).

A list of all other variables included in the different models together with a brief description of each, their respective source, and their expected effect on underpricing is provided in Table 8 of Appendix B. The variable selection is based on both previous underpricing literature, and the expert interviews conducted. The variables can be broadly categorized into firm-specific factors (*FirmAge, VC, PE, Revenues, Total Debt to Total Assets Ratio*), IPO-specific factors (*Bookrunners, Filing Price Revision*), Industry-specific factors (*Tech, Regulated, Financial*), macroeconomic factors (*MktReturn*), as well as stock exchange- and time-specific effects.

4.4. Research Design

The following section describes the methodology employed to test the hypotheses stated above in Section 3. First, Section 4.4.1 introduces the statistical framework used to test the effect that an IFA has on underpricing: A multivariate regression based on *Ordinary Least Squares (OLS)* estimators is implemented with *UP* as the dependent and *IFA* as an independent variable, while controlling for other factors. As a second step, a test for heteroscedasticity is applied. In the

subsequent Section 4.4.2, factors which impact the likelihood that a company engages an IFA are determined through the application of a binary response (*probit*) model.

4.4.1. Testing the Impact of IFAs on Underpricing

In order to establish whether the sample exhibits underpricing (**H1**), a two-sided t-test is applied. Underpricing exists if the test rejects the null hypothesis that the sample mean of first day initial returns is equal to zero against the alternative hypothesis that the mean is larger than zero (i.e. $Pr[T > t] < 0.05$). The t-test is applied to both the total sample and two subsamples. These subsamples were created by splitting the sample into two groups: (i) IPOs which involved an IFA (*IFA*=1), referred to as *Subsample IFA* henceforth, and (ii) IPOs which did not involve an IFA (*IFA*=0), referred to as *Subsample NIFA* henceforth. Once the presence of underpricing (**H1**) in the sample cannot be rejected, the subsequent hypotheses (**H2** and **H3**), i.e. the impact of IFAs on IPO pricing, can be tested.

As a first step to test whether the presence of an IFA in the IPO process reduces underpricing (**H2**), a two-sample t-test on the two subsamples created above is employed. The test determines if the means of the two groups are significantly different from each other. Next, the potential impact of IFAs on underpricing is analyzed in more detail using a linear regression model estimated with the *OLS* method. Initially, a simple bivariate model is applied with *UP* as dependent and *IFA* as independent variable. Hypothesis **H2** suggests that the coefficient β, describing the relationship between *UP* and *IFA*, is significantly different from zero and has a negative sign. In subsequent steps, the model is extended to the model below by controlling for other effects:

$$UP = \alpha + \beta IFA + \boldsymbol{X'\gamma} + \boldsymbol{TFE'\delta} + \boldsymbol{EFE'\varphi} + u \qquad (2)$$

To derive the model in Equation (2), the bivariate model is first extended to account for other factors that might impact underpricing by including control variables, a description of which can be found in Table 8 of Appendix B. In the model above (2), these variables are denoted by the vector $\boldsymbol{X}$. Next, time- and exchange-specific fixed effects, described by the vectors $\boldsymbol{TFE}$ and $\boldsymbol{EFE}$, are introduced to challenge the robustness of the results. Lastly, the *Best Fitted Model* is determined by using a *stepwise backwards regression* (Gujarati and Porter, 2009). This technique starts out with the multivariate model including all control variables (i.e. vector $\boldsymbol{X}$), and successively eliminates variables based on their significance level and their respective contribution to the explained sum of squares. The threshold significance level was set to 20%. This procedure ultimately results in the *Best Fitted Model* as determined by the highest *adjusted* R^2.

The subsequent analysis of **H3** (i.e. IFAs improve offer price accuracy) is based on this *Best Fitted Model*. Hypothesis **H3** implies that the variance of *UP* conditional on the presence of an IFA (*Var[UP| IFA=1]* vs. *Var[UP| IFA=0]*) is not constant but varies between the two subsamples. The analysis is carried out in two steps: First, it is tested whether the variance of *UP* conditional on all independent variables included in the *Best Fitted Model* is non-constant. In other words, it is tested if the error term *u* of the model is heteroscedastic. For this purpose, a *Breusch-Pagan Test* is applied. Second, a *Variance Ratio Test* is employed to test whether *IFA* itself is a source of heteroscedasticity. It should be noted that if heteroscedasticity does in fact exist, one of the principal assumptions of the *Gauss-Markov Theorem* is violated (Wooldridge, 2012). While the *OLS* method still provides unbiased estimates for the relationship between the predictor variables and the outcome variable in the case of heteroscedasticity, it is no longer the most efficient estimator. As standard errors of the regressors are biased, the statistical inference becomes suspect (Wooldridge, 2002). To account for heteroscedasticity and ensure the reliability of statistical inference, the *Weighted Least Squares* (*WLS*) method is applied. This issue is discussed in more detail in Section 6.

4.4.2. Identifying the Determinants of Appointing an IFA

This part of the analysis is designed to answer the second research question raised in Section 3: '*Who appoints an IFA?'* In other words, it is tested which firm characteristics affect the likelihood that a company employs an IFA. As *IFA* is defined as a binary variable, i.e. it only has two possible outcomes denoted by 1 and 0, a binary response (*probit)* model is estimated. The following specification is chosen based on Wooldridge (2002):

$$\mathrm{P}(IFA_i = 1|\, \boldsymbol{x}_i) = \phi(\boldsymbol{x}_i'\boldsymbol{\beta}), where\ i = 1,2, \dots, n \tag{3}$$

where P denotes the probability that *IFA*=1 and ϕ is the *Cumulative Distribution Function* (*CDF*) of the standard normal distribution. To test whether the size of the issuing company increases the likelihood of employing an IFA (**H4a**) and whether pre-IPO PE/VC ownership has a significant effect (**H4b**/**H4c**), as a first step, a *probit* model with only these hypotheses variables is estimated. In line with the hypotheses, it is expected that the variable *Revenue* (as a proxy for size) has a significant positive coefficient ($\beta_{i,2} > 0$). While the variables *PE* and *VC* are also expected to have a significant impact ($\beta_{i,3} \neq 0\ and\ \beta_{i,4} \neq 0$), the direction of the ownership effect is not yet obvious (refer to Section 3 for the underlying reasoning). Second, other control variables are added to test the robustness of the hypotheses variables' significance, resulting in the *Full (probit) Model*. Third, the *Full (probit) Model* is tested for its robustness against exchange-specific effects. Fourth, the *Best Fitted (probit) Model* is found via *stepwise*

backwards regression with a threshold significance level of 20%. As a last step, the marginal effects of the *Best Fitted (probit) Model*'s variables are derived to allow for a meaningful interpretation of the coefficients. The marginal probability effect of changing one particular covariate $X_j, j = 1, \dots, k$ differs between continuous and binary explanatory variables and is defined as follows (Arulampalam, 1999):

$$\frac{\partial[\mathrm{P}(\mathrm{IFA}_i=1|\,\boldsymbol{x}_i)]}{\partial X_{ij}} = \frac{d\phi(\boldsymbol{x}_i'\boldsymbol{\beta})}{d(\boldsymbol{x}_i'\boldsymbol{\beta})}\frac{\partial(\boldsymbol{x}_i'\boldsymbol{\beta})}{\partial X_{ij}}, if\ X_j\ is\ a\ continuous\ explanatory\ variable \quad (4)$$

$$\phi\big(\boldsymbol{x}_i'\boldsymbol{\beta}|\,X_{ij}=1\big) - \phi\big(\boldsymbol{x}_i'\boldsymbol{\beta}|\,X_{ij}=0\big), if\ X_j\ is\ a\ binary\ explanatory\ variable \quad (5)$$

As the marginal effects vary with the values set for the other regressors (denoted by vector $\boldsymbol{x}$), the last model's coefficients (model (5) in Table 5: *Marginal Effects*) provide the marginal probability effects holding all covariates constant at their respective means.

5. Empirical Results

The subsequent section describes the results obtained from carrying out the empirical tests described in Section 4.4. Its structure follows the order of the hypotheses as laid out in Section 3.

5.1. Hypothesis 1: Does Underpricing Exist?

Depicted in Table 2 below is the equally-weighted mean and the median level of underpricing for the final sample as well as for *Subsample IFA* (IPOs with IFA presence) and *Subsample NIFA* (IPOs without IFA presence). While the mean level of underpricing for the final sample in its entirety is 7.2%, it is equal to 4.6% for *Subsample IFA* and 8.5% for *Subsample NIFA.* These levels of mean underpricing are relatively low compared to other samples that span several decades, particularly when the internet bubble (i.e. the period 1999-2001) is included (e.g. Loughran et al. 2019). However, the levels observed for the sample are in line with recent studies that only take the current decade into account (e.g. Jenkinson et al. 2018). The median level of underpricing is considerably below the mean for the final sample and the two subsamples, indicating that the distribution of underpricing has so-called positive 'fat tails'. This is confirmed by the distribution of underpricing in Figure 5 of Appendix C. It should be noted that positive 'fait tails' are not unusual for underpricing data and they do not affect the subsequent analysis in any significant way, as shown in Section 6.

Table 2: The Presence of Underpricing in the IPO Sample

The table below shows the mean, median, minimum and maximum level of underpricing after one day of trading and after one week of trading for the final sample's IPOs that included an IFA and for those that did not.

Underpricing	Mean	Median	Min	Max
Underpricing first day	7.2%	4.4%	-23.7%	89.6%
With IFA	4.6%	2.6%	-15.8%	46.7%
Without IFA	8.5%	5.3%	-23.7%	89.6%
Underpricing first week	8.5%	5.0%	-30.6%	116.7%
With IFA	5.4%	3.8%	-25.9%	52.3%
Without IFA	10.1%	5.0%	-30.6%	116.7%

The results of the conducted two-sided t-tests are displayed in Table 10 of Appendix D. Both for the final sample and for the two subsamples *IFA* and *NIFA*, the t-test rejects the null hypothesis that mean first day initial returns are equal to zero in favor of the alternative hypothesis that underpricing (i.e. positive first day initial returns) exists. Hence, there is strong evidence for the existence of underpricing in the sample (**H1**). When measured as first week returns, both mean and median levels of underpricing are slightly higher than when measured as first day

initial returns, but the general pattern is identical. The same t-tests were conducted for first week returns, and identical results obtained.[14]

5.2. Hypothesis 2: Does an IFA Mitigate Underpricing?

The t-tests above established that underpricing is present in both subsamples, implying that the involvement of an IFA does not completely eradicate underpricing. However, the lower mean level of underpricing for *Subsample IFA*, as depicted in Table 2, implies that an IFA might have a mitigating effect on underpricing (**H2**). The two-sample t-test on the significance of the observed difference (see Table 10 of Appendix D) confirms that mean underpricing of *Subsample IFA* is in fact significantly lower than that of *Subsample NIFA*.[15] This potentially mitigating effect warrants a more detailed analysis.

The pairwise correlations between *UP*, *IFA*, and the control variables (Table 9, Appendix B) further strengthen hypothesis **H2**: *UP* and *IFA* have a significant, negative correlation at the 5% significance level. The results of an *OLS* estimation are depicted in Table 3 on the next page. They suggest that the impact of *IFA* on *UP* is highly significant and robust across all estimated models (1-5): *IFA* is significant at the 1% level in the *Bivariate Model*, and when including other control variables (*Full Model*).[16] The significance remains robust at the 1% level when controlling for time-specific fixed effects (model 3). In the model that includes exchange-specific fixed effects (model 4), *IFA* maintains significant at the 5% level. In line with the expectations (**H2)**, the coefficient for *IFA* is negative in all five regressions. Taking both the significance and direction of the effect into account, the analysis above provides strong empirical evidence in favor of **H2** - the presence of an IFA in the IPO process does mitigate underpricing.

[14] T-tests conducted for first week returns showed identical results but are not displayed as a matter of conciseness.
[15] To ensure the robustness of the results in light of the heteroscedasticity established in the subsequent Section 5.3, a two-sample Wilcoxon rank-sum test and a two-sample t-test with unequal variances were applied. The results of these tests, which are illustrated in Table 10 of Appendix D, confirm the significant difference between underpricing across the two subsamples *IFA* and *NIFA*.
[16] The variables *Total Debt to Total Assets Ratio* and *Filing Price Revision* were each tested for a subsample as data was not available for all observations. Both variables did not exhibit significant effects. In the interest of conciseness, the results are not displayed in the thesis.

Table 3: The Impact of an IFA on Underpricing – OLS Regression Results

*The analyzed sample consists of 373 Western European IPOs from the years 2012-2019, of which 126 involved an IFA. The table shows the outcomes of OLS regression models of UP on IFA (study variable) and several control variables. Model (1) only includes the binary variable IFA for which the value 1 denotes IFA presence. While model (2) includes all other independent variables, the Best Fitted Model (5) is obtained through a stepwise backwards regression. Models (3) and (4) test the robustness of the results controlling for time- and exchange-specific effects. The dependent variable UP is specified as first day initial returns in percent. Tech, Regulated and Financial are industry dummies, which are equal to 1 if a company belongs to the respective industry. NonEuropean is set to 1 if a firm is not incorporated in a European country. FirmAge is equal to the logarithm of the firm's age in years at the IPO date plus one. Revenues is used as a proxy for size and obtained by taking the logarithm of one plus the company's last twelve months revenues prior to the IPO. PE and VC are binary variables with a value of 1 in case of pre-IPO PE or VC ownership respectively. Bookrunners equals 1 if the IPO involved multiple bookrunners. MktReturn is the average daily return in the 30 days prior to the IPO of the Morgan Stanley Capital International (MSCI) Europe index. For a detailed definition of the dependent variable UP and the study variable IFA refer to Section 4.3 above. Control variables are further explained in Table 8 of Appendix B. The robust standard errors for each variable obtained through the sandwich (robust covariance matrix) estimator are reported in parentheses. The significance level is denoted by asterisks at the ***(1%), **(5%), and *(10%) level.*

VARIABLES	(1) Bivariate Model	(2) Full Model	(3) Time Fixed Effects	(4) Exchange Fixed Effects	(5) Best Fitted Model
IFA	-0.0390***	-0.0372***	-0.0378***	-0.0293**	-0.0342**
	(0.0124)	(0.0140)	(0.0138)	(0.0147)	(0.0133)
Tech		-0.00160	0.00130	0.00290	
		(0.0162)	(0.0165)	(0.0168)	
Regulated		-0.0721	-0.0765*	-0.0577	
		(0.0445)	(0.0436)	(0.0381)	
Financial		-0.00354	-0.00118	-0.00200	
		(0.0173)	(0.0175)	(0.0175)	
NonEuropean		-0.0232	-0.0187	-0.0372*	
		(0.0208)	(0.0212)	(0.0215)	
FirmAge		0.0122**	0.0120*	0.0120*	0.0155***
		(0.00584)	(0.00619)	(0.00633)	(0.00406)
Revenues		0.00329	0.00272	0.00394	
		(0.00440)	(0.00446)	(0.00461)	
PE		-0.0392**	-0.0328*	-0.0373**	-0.0344**
		(0.0157)	(0.0170)	(0.0175)	(0.0135)
VC		-0.0315	-0.0287	-0.0167	-0.0355*
		(0.0264)	(0.0292)	(0.0258)	(0.0215)
Bookrunners		-0.0245*	-0.0249	-0.00916	-0.0184
		(0.0148)	(0.0153)	(0.0171)	(0.0140)
MktReturn		0.126	1.908	-0.695	
		(4.109)	(4.370)	(4.059)	
Constant	0.0848***	0.0663***	0.0685	0.0305	0.0620***
	(0.00886)	(0.0194)	(0.0439)	(0.0295)	(0.0141)
Observations	373	372	372	372	373
R-squared	0.021	0.072	0.084	0.087	0.063
Exchange				YES	
Year			YES		

The *Best Fitted Model* is obtained by *stepwise backwards regression* and defined as follows[17]:

$$UP = \alpha + \beta IFA + \gamma_1 FirmAge + \gamma_2 PE + \gamma_3 VC + \gamma_4 Bookrunners + u \qquad (6)$$

The coefficient β, which describes the impact of *IFA* on *UP*, is significant at the 5% level and has a value of -0.0342. This means, ceteris paribus, that the presence of an IFA during an IPO process mitigates underpricing by c. 3.42 percentage points. This effect is very similar in magnitude and direction to that of *PE* (3.44 percentage points) and *VC* (3.55 percentage points). Whereas *PE* and *VC* have a mitigating effect on underpricing in accordance with prior academic literature (Table 8, Appendix D), the effect of *FirmAge* is not as anticipated. The positive coefficient of *FirmAge* indicates that firms with longer operating history experience higher underpricing. While the sign of the coefficient for *Bookrunners*, γ_4, is as anticipated, the variable is no longer significant in the *Best Fitted Model*. The model's *R-squared* appears to be comparatively low at 6.3%. However, this is to be expected in regression models examining underpricing. As noted by Beatty and Ritter (1986), a high *R-squared* would imply that the realized initial returns of newly issued shares could be predicted by a model. Yet, this would contradict the basic theory that underpricing is to some extent caused by ex-ante uncertainty and thus not foreseeable.

Finally, there are two implications that warrant further discussion: First, although the analysis above shows that IFAs appear to have a significant, mitigating impact on underpricing, it does not allow for an inference as to how exactly IFAs mitigate underpricing. Specifically, it does not explain whether IFAs reduce ex-ante uncertainty through signaling (e.g. by certifying the quality of a company through their own reputation), or by mitigating the potential agency conflict between investment banks and issuing companies. As these theories are not mutually exclusive, it could also be a combination of both.[18] Second, the assertion that the presence of IFAs mitigates underpricing on its own is not sufficient to conclude that IFAs are in fact beneficial to companies going public. To see why, one must consider that the company also incurs costs from engaging an IFA. If the decision to appoint an IFA is made based on the expected cost savings from reduced underpricing, actual net benefits only occur if the marginal benefits of reduced underpricing exceed marginal costs of appointing an IFA.

[17] The variable *Bookrunners* is included in the *Best Fitted Model* as the threshold significance level for the elimination of variables in the stepwise procedure was set to 20%. At this level, *Bookrunners* is still significant.
[18] The inclusion of an interaction term in the *Best Fitted Model* to shed further light on this question was considered, but ultimately dismissed as the results did not provide any additional insights. Being able to draw a clear distinction between the two possible effects should be the goal of future research on the topic, as laid out in Section 8.

Based on the *Best Fitted Model*, the marginal benefits of an IFA can be computed for the average sample company (i.e. all other independent variables are set to their means): The average company, which does not employ an IFA (*IFA*=0) is expected to experience c. 8.3% underpricing, which results in c. 19.47 million euros of transaction volume 'left on the table'.[19] All other things equal, companies are expected to forego only c. 11.45 million euros in proceeds when advised by an IFA (*IFA*=1), resulting in c. 8.01 million euros in additional proceeds raised compared to the case with no IFA present. This would imply that an IFA could charge up to 3.42% of total proceeds raised in the IPO for marginal costs of employing an IFA not to exceed marginal benefits (i.e. a positive net benefit). This appears to be a comparatively high threshold for IFA fees, assuming that IFAs charge fees similarly to/below conventional IPO investment banking fees of 2-4% in the European IPO market (Abrahamson et al., 2011). This also suggests that the mitigating effect of IFAs on IPO pricing is similar in magnitude to the costs of appointing investment banks to carry out a bookbuilt IPO. However, it is important to note that company size is likely a key factor in this calculation. Since IFAs presumably have a minimum (fixed) fee below which it is not economically feasible for them to advise an IPO, relative costs for small IPOs might be considerably higher. Furthermore, IFA fees defined as a percentage of proceeds raised are likely decreasing in the relative size of the IPO, further cementing this size factor.[20] This idea is further explored in Section 5.3.

Finally, it is important to note that while reduced underpricing might be beneficial to issuing firms, overpricing of the issued shares is not desirable for firms either. The subsequent section addresses this issue by examining the potential effect of IFAs on price accuracy in an IPO.

5.3. Hypothesis 3: Does an IFA Improve the Accuracy of the Offer Price?

As stated above, not only underpricing but also overpricing is considered an issue to the owners of a company. For instance, financial owners such as PE and VC investors face the risk of long-term reputational damage when institutional investors that participate in the IPO incur considerable losses due to overpricing. This constitutes a considerable risk as PE/VC investors will likely return to the IPO market when exiting a different investment (Barry, 1994). Moreover, the company itself might want to return to the equity capital market to raise new funds. This could be substantially more difficult with a track record that includes an overpriced IPO (Booth

[19] Calculated as average proceeds raised in the sample (234.35 million euros) multiplied by the percent of underpricing estimated by inserting the variables' means into the *Best Fitted Model* and setting *IFA*=0.

[20] In other words, a structure similar to that of investment banks can be expected. Investment banks might be able to charge a fee up to 4% of proceeds raised for a small IPO but may only be able to charge 0.5% on an IPO exceeding the billion euros mark.

and Smith, 1986). Thus, the mitigating effect on underpricing alone is not sufficient to establish that IFAs provide marginal benefits as the results could, in principle, be driven by a few highly overpriced IPOs that included IFAs. Instead, another requirement has to be fulfilled for a final assessment on the potential benefits of IFAs related to IPO pricing: IFAs must improve the accuracy of the offer price and not just mitigate underpricing (**H3**).

To investigate the validity of this hypothesis (**H3**), the *Best Fitted Model* is examined for heteroscedasticity, i.e. a non-constant variance of the error term *u*. The scatterplot of the *Best Fitted Model* between the fitted values and the residuals shows that the dispersion of the residuals increases with the fitted values (Figure 6, Appendix D). This indication of heteroscedasticity is confirmed by a *Breusch-Pagan test* with a highly significant p-value (below 1%).

Given that the *Best Fitted Model* exhibits heteroscedasticity, it is subsequently tested whether the two subsamples defined in Section 4.4.1 (*Subsample IFA* and *Subsample NIFA*) have different variances. Examining the scatterplot between the dependent variable *UP* and the study variable *IFA* (Figure 7, Appendix D), a greater dispersion, into both the positive and the negative spectrum of the dependent variable *UP* is observed in the case of no IFA presence during the IPO process. The histogram of *UP* for the two subsamples in Figure 7 gives further support to this observation. To test the robustness of this finding, a *Variance Ratio Test* is conducted (Table 10, Appendix D), which tests whether the ratio between the two subsamples' standard deviations is equal to one:

$$H_0: \frac{sd(IFA = 0)}{sd(IFA = 1)} = 1 \;\; against\ the\ three\ alternatives: \begin{cases} H_a\ ratio < 1 \\ H_a\ ratio \neq 1 \\ H_a\ ratio > 1 \end{cases}$$

While the p-value is insignificant when testing H_0 against the first alternative ($H_a\ ratio < 1$), the p-value is significant at the 1% level for the two other alternatives ($H_a\ ratio \neq 1$ and $H_a\ ratio > 1$). Consequently, the *Variance Ratio Test* rejects H_0 in favor of a higher dispersion, as measured by the standard deviation of the dependent variable *UP*, for *Subsample NIFA* (i.e. *IFA*=0). Therefore, strong empirical evidence is found in support of hypothesis **H3**, i.e. that the involvement of an IFA in an IPO process improves the accuracy of the offering price. In conclusion, the findings suggest that hiring an IFA not only mitigates underpricing in an IPO but also lowers the dispersion of underpricing. In combination, these two effects provide benefits to companies going public. Having established this apparently beneficial role of IFAs in the pricing of an IPO, the subsequent section examines what type of companies appoint an IFA.

5.4. Hypothesis 4a-c: Who appoints an IFA?

In order to approach the second research question, '*Who engages an IFA?*', Table 4 on the next page provides descriptive statistics of firm characteristics that potentially influence the likelihood that a company decides to employ an IFA. These firm characteristics are mainly derived from expert interviews conducted within the scope of this paper (see Appendix F). The statistics are presented for the entire final sample and grouped by the study variable *IFA.*

Table 4: Descriptive Statistics of Selected Variables

The table provides descriptive statistics of selected variables for the final sample and the two subsamples (IFA=1 vs. IFA=0). The final sample consists of 373 Western European IPOs between 2012 and 2019. 126 (approx. one third) of these IPOs involved an IFA during the IPO process and 247 (approx. two thirds) did not.

	Total Sample		IFA		Non-IFA	
	Mean	Median	Mean	Median	Mean	Median
Tech	0.29	0	0.25	0	0.31	0
Regulated	0.01	0	0.01	0	0.01	0
Financial	0.18	0	0.21	0	0.16	0
PE	0.15	0	0.24	0	0.10	0
VC	0.15	0	0.16	0	0.14	0
Firm Age (in years)	25	14	31	18	22	12
Revenues (in EUR m)	583	42	1,145	141	296	21
Proceeds (in EUR m)	234	69	392	209	154	52

Jenkinson et al. (2018) show that IPOs involving an IFA are on average larger in terms of transaction value. Table 4 above corroborates this result as both the mean and median value of proceeds raised are substantially higher for the group of IPOs that involved an IFA. In the subsequent *probit* models, *Revenues* is used as an independent variable to measure size effects instead of the transaction value since proceeds raised is an ex-post (i.e. after the IPO) measure, whereas the decision to employ an IFA is taken ex ante (i.e. before the IPO).[21] Firm revenues might not be a perfect proxy for the size of the IPO itself since the transaction volume of an IPO depends on other factors such as a firms' decision on how much ownership to sell publicly. However, the final sample data exhibit a high and significant correlation of approximately 60% between proceeds raised in the IPO and the pre-IPO revenues of the issuing firms.

Table 4 further illustrates that the subsample of companies that engaged an IFA is more likely to be PE-backed. While 24% of the companies that employed an IFA had PE shareholders prior to the IPO, this was only the case for 10% of the companies without an IFA. Regarding pre-IPO VC ownership, no substantial distinction between the two subsamples is detected. It is important to note that no conclusion can be drawn for hypotheses **H4b-c** at this stage of the

[21] Anticipated proceeds raised (computed by multiplying the shares to be sold by the midpoint of the filing price range) should not be used as a proxy for size either in the *probit* model as they are also an ex post measure, i.e. mostly determined after the decision to appoint an IFA.

analysis as the (non-)observed differences could potentially be explained by another firm characteristic such as size. Avoiding premature inferences is of particular importance in this context as PE ownership is usually associated with a larger firm size relative to VC ownership. This is also applicable for this sample since *PE* shows a significantly positive correlation with *Revenues*, whereas *VC* exhibits a significantly negative correlation with *Revenues* (see respective bivariate correlations in Table 9 of Appendix B). In short, pre-IPO PE owned companies in the sample are on average larger than pre-IPO VC owned companies. To make valid statistical inferences with respect to hypotheses **H4a-c**, a binary response (*probit*) model is estimated, the results of which are presented below in Table 5 on the next page.

The *Best Fitted (probit) Model* is determined by *stepwise backward regression* and specified as follows:

$$\mathrm{P}(\mathrm{IFA}_i = 1 | \, \boldsymbol{x}_i) = \phi\left(\beta_{i,1} Financial_i + \beta_{i,2} Revenues_i + \beta_{i,3} PE_i + \beta_{i,4} VC_i + u_i\right) \quad (7)$$

Revenues as a proxy for company/IPO size is found to be the most robust firm characteristic affecting the likelihood of IFA presence in an IPO process. The coefficient is significant at the 5% level in all models (1-5) including model (3), which accounts for exchange-specific effects. As expected, the coefficient for *Revenues* exhibits a positive sign, providing strong support for hypothesis **H4a**: Larger companies appear indeed more likely to appoint an IFA. This might be due to the costs associated with hiring an IFA. As explained in Section 3, IFAs might charge fixed minimum fees or higher percentages of proceeds raised for smaller IPOs. As a consequence, relative costs are substantially higher for small firms, making it less likely that these firms appoint an IFA. This finding has an important economic implication: Although IFAs are likely to have a beneficial effect on IPO pricing (Section 5.2 & Section 5.3), they cannot be considered an overall solution to the underpricing issue as it appears to be economically unfeasible for certain (small) companies to resort to the services of an IFA. Another potential, but not mutually exclusive explanation for the size effect could be that larger IPOs are associated with a higher level of complexity and coordination effort as a result of, for example, the involvement of more parties (e.g. multiple bookrunners). Thus, IFA services such as intermediation and coordination could potentially be more beneficial in such larger-scale IPOs.

Table 5: Determinants of Appointing an IFA – Probit Model Results

*The analyzed sample consists of 373 Western European IPOs from the years 2012-2019, of which 126 involved an IFA. The table shows the outcome of binary response (probit) models with IFA as the dependent binary variable. Model (1) only contains the hypotheses variables. While model (2) includes all variables, the Best Fitted (probit) Model (4) is found via stepwise backwards regression. Model (3) tests the robustness of the results controlling for exchange-specific fixed effects. Model (5) reports the marginal effects at covariates' means for the Best Fitted (probit) Model (4). Tech, Regulated and Financial are industry dummies, which are equal to 1 if a company belongs to the respective industry. Revenues is used as a proxy for size and obtained by taking the logarithm of one plus the company's last twelve months revenues prior to the IPO. FirmAge is equal to the logarithm of the firm's age in years at the IPO date plus one. PE and VC are binary variables with a value of 1 in case of pre-IPO PE or VC ownership respectively. NonEuropean is set to 1 if a firm is not incorporated in a European country. For a more detailed definition of the dependent variable IFA refer to Section 4.3 above. The independent variables are further explained in Table 8 of Appendix B. The robust standard errors for each variable obtained through the sandwich (robust covariance matrix) estimator are reported in parentheses. The significance level is denoted by asterisks at the ***(1%), **(5%) and *(10%) level.*

VARIABLES	(1) Hypotheses Variables	(2) Full Probit Model	(3) Exchange Fixed Effects	(4) Best Fitted Probit Model	(5) Marginal Effects
Tech		0.188	0.0325		
		(0.181)	(0.195)		
Regulated		0.155	-0.181		
		(0.649)	(0.663)		
Financial		0.477**	0.248	0.405**	0.151**
		(0.205)	(0.222)	(0.194)	(0.0752)
Revenues	0.174***	0.182***	0.101**	0.179***	0.0640***
	(0.0321)	(0.0382)	(0.0404)	(0.0317)	(0.0113)
FirmAge		0.0291	0.110		
		(0.0789)	(0.0829)		
PE	0.300	0.348*	0.140	0.338*	0.126*
	(0.199)	(0.207)	(0.223)	(0.204)	(0.0790)
VC	0.467**	0.532**	0.230	0.574***	0.218***
	(0.211)	(0.217)	(0.238)	(0.214)	(0.0838)
NonEuropean		-0.0448	0.398		
		(0.347)	(0.399)		
Constant	-1.222***	-1.491***	-0.733**	-1.340***	
	(0.154)	(0.235)	(0.307)	(0.155)	
Observations	373	373	373	373	373
Pseudo R^2	0.0967	0.109	0.197	0.107	0.107
Exchange			YES		

PE only has a significant impact at the 10% level in the *Full* and *Best Fitted (probit) Model*, but no statistically significant effect in model (1) and model (3). As a result, the findings do not provide sufficient evidence to support **H4b**: PE ownership prior to an IPO is not found to significantly affect the likelihood of appointing an IFA.

The significance of *VC* at the 1% level in the *Best Fitted (probit) Model* and at the 5% level across the other models, except when accounting for exchange-specific fixed effects (model 3),

provides supportive evidence for hypothesis **H4c**. Section 3 hypothesizes that the impact of pre-IPO VC ownership is linked to the owners' experience with IPOs and their higher level of financial sophistication. As explained in Section 3, this could have two opposing implications: On the one hand, VC owners' higher level of financial sophistication could raise awareness of the complexities during an IPO process and thus increase the likelihood to appoint an IFA. On the other hand, marginal benefits of an IFA could diminish as the level of financial sophistication of the pre-IPO owners increases, and thus make VC-backed IPOs less likely to hire an IFA. The *Marginal Effects* (at covariates' means) of the *Best Fitted (probit) Model* (model 5 of Table 5) above provide evidence for the first of the two alternatives: The coefficient for *VC* β_4 has a value of +0.218. For an average IPO, i.e. all covariates of the model equal to their means (see Table 4 for the covariates' means), pre-IPO VC ownership (*VC*=1) increases the likelihood of appointing an IFA by approximately 22% compared to the case without pre-IPO VC ownership (*VC*=0). It appears that owners who frequently participate in IPOs are more educated regarding the complexities of the process as well as the potential conflicts of interests. In consequence, they show a higher appreciation for the services of an IFA. An alternative explanation for the positive effect of pre-IPO VC ownership on the likelihood to appoint an IFA could be related to VCs' established banking relationships prior to the IPO. VCs most likely strive to appoint the most qualified investment bank(s) when conducting an IPO. At the same time, it seems likely that VCs seek not to risk their established relationships with banks on which they frequently rely for other services, such as bridge loans and funding for portfolio companies. Hence, the appointment of an IFA could allow VCs to stay 'neutral' during the underwriter selection process by leaving this task primarily to the IFA.

In addition, there is another implication concerning the underlying cause of IFAs' mitigating effect on underpricing that can be derived from this result. As pointed out in Section 5.2, no final conclusion can be drawn as to whether the mitigating effect of IFAs on underpricing is rooted in an agency conflict, or the signaling theory. However, the significant impact of *VC* on the likelihood to appoint an IFA may provide some insights regarding this question: As illustrated in Section 2.2.2, VC ownership is presumed to decrease ex-ante uncertainty in the context of the signaling theory by certifying the quality of the issuing company. Given that VCs themselves already appear to have a certifying effect, a 'double certification' by both the VC owner and the IFA as motivation for a VC to hire an IFA could be considered rather implausible. Therefore, this may be interpreted as evidence in favor of IFAs beneficial role in mitigating the agency conflict between issuers and investment banks, instead of IFAs beneficial role in the context of the signaling theory.

Furthermore, the results suggest that industry effects play a role when determining the likelihood that a company hires an IFA. The coefficient of *Financial*, β_1, is significant in all estimated models except when controlling for exchange-specific fixed effects (model 3). This effect might be explained in a similar fashion to the variable *VC* – a relatively higher level of financial sophistication within the issuing company.

As stated above, both *VC* and *Financial* are not significant in model (3), implying that exchange-specific fixed effects have a considerable impact in the model. A more detailed analysis of these fixed effects revealed *London AIM* as the primary underlying cause, with a substantial, and statistically significant, negative effect.[22] Given that only 10 out of 114 IPOs at the *London AIM* relied on an IFA (see Figure 4), this effect is to be expected. Two factors appear to be important in this context: (i) As mentioned in Section 4.2, companies that list at the *London AIM* are primarily small- to mid-cap, growth-oriented companies, for which IFAs might be economically unfeasible. (ii) As stated in Section 2.3.1, a company listing at the *London AIM* is required to appoint a 'Nominated Adviser'. While not identical to an IFA, this 'Nominated Adviser' does perform some advisory services similar to that of an IFA. While the former effect (i) should mostly be accounted for by the size proxy *Revenues*, the latter (ii) provides an example of a potential exchange-specific characteristic that may influence the likelihood to appoint an IFA. A detailed examination of exchange-specific characteristics and their underlying causes, however, is beyond the scope of this thesis. An issue of endogeneity, or more specifically simultaneity, i.e. IFAs driving this exchange-specific effect by advising companies to list primarily at certain exchanges and less frequently at others seems unlikely: Although IFAs may advise issuers on where to list, an optimal listing location is primarily determined by the issuer's individual characteristics. For instance, the *London AIM* is specifically designed for smaller, growth-oriented companies, meaning a listing of companies exceeding a certain size threshold at this exchange does not seem sensible in any case.

In summary, there appears to be strong evidence in support of a positive impact of firm size on the likelihood to appoint an IFA (**H4a**). The paper finds no sufficiently significant evidence for an impact of pre-IPO PE ownership (**H4b**). VC ownership, however, seems to increase the likelihood of employing an IFA, lending support to hypothesis **H4c**. In addition, the empirical results suggest a significant, positive effect for an affiliation of the issuing company with the financial industry.

[22] The results were obtained by running the *probit* model including all the exchange-specifc variables defined in Table 8 in Appendix B.

6. Robustness Tests

The preceding Section 5 established a significant causal relationship between the presence of an IFA and underpricing. To verify these results and ensure their statistical reliability, several robustness checks have been carried out. According to Lu and White (2014, p. 194), the previously estimated regression coefficients can be deemed "*true causal effects of the associated regressors"* if the coefficients experience only small changes and remain significant under various robustness checks.

Testing the Assumptions of the OLS Procedure

To test the validity of the results, some of the basic assumptions of an *OLS* regression model have been tested for the *Best Fitted Model*: whether (i) the residuals are normally distributed, whether (ii) no collinearity exists between the independent variables, and whether (iii) the variance of the error terms is constant (i.e. homoscedastic) for the values of the independent variables.

The normality of the residuals was scrutinized by looking at the *histogram* and the *Q-Q normality plot* of the residuals, as well as by applying the *Shapiro-Wilk test*. While the *histogram* and *Q-Q normality plot* (Figure 8, Appendix E) do not seem to indicate substantial deviations from the normality assumption, the *Shapiro-Wilk test* rejected the null hypothesis of normally distributed residuals (Table 10, Appendix D). The issue of non-normality was addressed by estimating all models with robust standard errors using the sandwich (robust covariance matrix) estimator, and by testing a sub-sample for which the normality assumption held after the removal of outliers. Both adjustments only led to marginal differences in the value of the coefficients compared to the original models. Moreover, the same independent variables, including the study variable, remained highly significant at the 5% level.

As a second step, the independent variables were tested for multicollinearity. First, the bivariate correlations between the variables were derived. As observed from the pairwise correlations in Table 9 of Appendix B, none of the variables simultaneously tested exhibit a correlation in absolute terms of more than 0.4 with each other. Thus, there does not seem to be an issue with multicollinearity. As correlation and collinearity are not identical, the *Variance Inflation Factors* (*VIF*) were derived for all variables of the *Best Fitted Model*. A *VIF* value above a threshold of 10 is usually assumed to indicate multicollinearity (Alin, 2010). The *VIF* results corroborate that there is no issue of multicollinearity: the mean *VIF* is 1.11 and the maximum VIF of all

variables is 1.16 (Table 11, Appendix D). The same test was conducted for the independent variables of the *Best Fitted (probit) Model* and no collinearity was observed.

The Weighted Least Squares Estimation

As outlined in Section 5.3 various tests suggest the presence of heteroscedasticity in the *Best Fitted Model*'s error terms. Due to this violation of an assumption of the *Gauss-Markov Theorem,* the *OLS* estimators are no longer the most efficient estimators (Wooldridge 2012).[23] Instead, the *Weighted Least Squares* (*WLS*) procedure is applied as it corrects for the presence of heteroscedasticity, leading to more efficient estimators compared to *OLS* method.

The *WLS* procedure, as executed in this section, is based on the method proposed by Wooldridge (2012). As the assumption of a constant variance of *u* conditional on the independent variables, henceforth denoted by vector $\boldsymbol{Z}$ (i.e. $Var[u|\,\boldsymbol{Z}] = \sigma^2$), no longer holds in the case of heteroscedasticity, the variance has to be defined as a function of the independent variables. The function selected for the estimation is given by:

$$\mathrm{Var}(u|\,\mathbf{Z}) = \sigma^2 \exp(\boldsymbol{Z}'\boldsymbol{\delta}) \tag{8}$$

where $\boldsymbol{\delta}$ is a column vector of unknown parameters. While the remainder of this subsection only discusses the results of the *WLS* estimation, a detailed explanation of the applied *WLS* procedure can be found in Appendix E.

The *WLS* estimation produces new standard errors and t-statistics, which can be interpreted in the same way as in an *OLS* model. As illustrated in Table 6 on the next page, the significance of the *IFA* coefficient β has improved. This is to be expected since the *WLS* procedure gives more weight to observations that experience less variance (i.e. when *IFA*=1). The magnitude of IFAs' mitigating effect on underpricing has slightly increased to 3.59 percentage points, compared to 3.42 percentage points in the *Best Fitted Model* estimated with *OLS*.

It should be noted that the estimates for the coefficients are never identical across the two procedures. Yet, they should not substantially differ from each other (e.g. there should be no change in the sign of a coefficient). A substantial difference in coefficients between the two procedures could imply that the assumed function for heteroscedasticity in Equation (8) above is misspecified. In case of a misspecification of the functional form of the variance, the *WLS*

[23] The issue of heteroscedasticity needs to be addressed in the *OLS* model, whereas heteroscedasticity is a prerequisite in a *probit* model for reasonable results as homoscedasticity would imply that the slope of all parameters is zero (Wooldridge, 2002).

model is no longer guaranteed to be more efficient than the *OLS* model. Thus, the coefficient estimates of the two procedures should be compared. As there is no substantial difference in coefficients for the two models observed (see Table 3 for results with an *OLS* estimation and Table 6 below for results with a *WLS* estimation), the function appears to be well specified. Hence, the *WLS* estimators can be considered more efficient.

Table 6: The Impact of an IFA on Underpricing – WLS Regression Results

*The analyzed sample consists of 373 Western European IPOs from the years 2012-2019, of which 126 involved an IFA. The table reports the results of the estimated WLS model on the Best Fitted Model (see Table 3 in Section 5.2). The dependent variable UP is specified as first day initial returns in percent. The study variable IFA is an indicator variable with a value of 1 in case of IFA presence. FirmAge is equal to the logarithm of the firm's age in years at the IPO date plus one. PE and VC are binary variables with a value of 1 in case of pre-IPO PE or VC ownership respectively. Bookrunners equals 1 if the IPO involved multiple bookrunners. The robust standard errors for each variable obtained through the sandwich (robust covariance matrix) estimator are reported in parentheses. The significance level is denoted by asterisks at the ***(1%), **(5%) and *(10%) level.*

VARIABLES	IFA	FirmAge	VC	PE	Bookrunners	Constant
(1) WLS Best Fitted Model	-0.0359***	0.0191***	-0.0358**	-0.0355**	-0.0172	0.0530***
	(0.0134)	(0.00531)	(0.0179)	(0.0172)	(0.0133)	(0.0154)
Observations	373					
R-squared	0.081					

Tests Based on Sample Variation

In addition to the tests that focus on the crucial assumptions underlying an *OLS* estimation, two more robustness checks were conducted: (iv) estimating the *Best Fitted Model* after removing outliers via the *winsorizing* method, and (v) estimating the *Best Fitted Model* with first week initial returns rather than first trading day initial returns.

Given the limited sample size of 373 IPOs, spurious outliers have the potential to distort the results of the applied regression models (Carlson et. al., 2013). Therefore, the previous *OLS* model is re-estimated with *winsorized* (first day) underpricing data using cut-offs at the 5% and 95% percentile. *Winsorization* sets all outliers beyond these boundaries equal to the respective 5^{th} and 95^{th} percentile values. Applying this method to the final sample, the minimum value of *UP* increases from -23.7% to -7.2% and the maximum value of *UP* decreases from +89.6% to +33.3%. While median underpricing of the sample must remain the same under the *winsorizing* approach, mean underpricing decreases from 7.2% to 6.9%. As depicted in Table 12 of Appendix D, the coefficients of the *Best Fitted Model* do not change substantially, and significance levels are unaffected.

As a last robustness check (Table 13, Appendix E), the event window of the dependent variable underpricing is extended: Instead of using the closing price of the first trading day to compute underpricing, the variable *UPweek* is employed. *UPweek* measures the percentage difference

between the historical closing price on the last day of the first trading week and the offer price. Klein (1996) refers to a trade-off when extending the event window. While first day initial returns may be distorted due to immediate price stabilization activities by the underwriter, weekly initial returns could be biased because of potential noise created by information revelation within the first trading week. When using *UPweek* as dependent variable, the independent variable *VC* loses its significance (previously significant at the 10% level). The study variable *IFA*, however, turns out to be even more significant, at the 1% level (previously significant at the 5% level) in the *Best Fitted Model*.

Various robustness checks have corroborated the results of Section 5. The coefficient of the study variable *IFA* only changes marginally and remains significant in all robustness tests at the 5% level. Therefore, the effect of IFAs on underpricing appears to be robust.

7. Caveats

An extensive body of academic literature focusing on the topic of IPO underpricing has been created over the last decades. However, the role of IFAs in the context of underpricing has received essentially no attention so far. Due to the novelty of this topic, there is hardly any academic literature to which the results can be compared to. Although several robustness checks have been conducted to test the validity of the obtained results, it is important to discuss potential caveats of this paper that may confine the explanatory power of the analyses. The purpose of this section is to raise awareness of these limitations and explain their respective implications.

Sample Size and Data Collection

The sample size of 373 IPOs, while not untypical for research focused on IPOs given the difficulty of obtaining data (e.g. Jenkinson et al., 2018; Liu and Ritter, 2010), nonetheless limits the statistical power of the results obtained in Section 5. The opportunity to extend the sample size was primarily restricted by two factors: First, the frequent participation of IFAs in IPOs is a comparatively recent phenomenon, limiting the possibility to expand the sample through an extension of the time period. Second, the appointment of an IFA seems to be more common in European IPOs (Jenkinson et al., 2018), which limits the possibility to extend the sample by including IPOs from other highly developed capital markets such as that of the United States. Moreover, the exclusive focus on Western European IPOs is aimed at retaining sufficient comparability among the different exchanges with respect to the varying regulatory environment. Despite the high level of comparability between Western European exchanges due to common European standards and regulatory requirements, exchange-specific effects do seem to affect some of the results. However, examining the specific differences in regulations across exchanges goes beyond the scope of this thesis.

For some variables, including the study variable *IFA*, the data collection had to be performed manually. This might be regarded as a caveat for three principal reasons. First, when missing values in the original databases have to be complemented with data from other sources, there is a risk that the methodology of collection and measurement may deviate from the one of the *SDC Platinum* database, leading to potential inconsistencies in the dataset.[24] Second, the

[24] Such cases were approached in the following way: (i) Existing data in *SDC Platinum* were searched manually and subsequently compared to the existing values in the database. (ii) If the data were found to be consistent, missing values were replaced through a diligent research method. For instance, when replacing missing values on revenue data, these values were all derived from the prospectus of the issuing companies. As a cross-check, these values were compared to the existing values for revenue in the *SDC Platinum* database.

manual research process is prone to human error. Although the data collection for the study variable *IFA* was approached in a systematic way and with due diligence (see Section 4.1), potential mistakes cannot be ruled out. Third, some level of trust had to be placed on the reliability of the sources used. While IPO prospectus are subject to extensive regulations and compiled by reputable investment banks and law firms, there are still risks of mistakes. Finally, although the data has been audited repeatedly with sufficient caution, some of the variables such as *Revenues* and *FirmAge* do not exhibit the expected effect on underpricing that has been observed in prior academic papers (compare the results in Table 3 of Section 5.2 with the expected effects based on previous academic findings as illustrated in Table 8 of Appendix B).

Apart from potential issues related to complementing data for missing values, some information was simply not consistently available. For instance, other control variables that could not be obtained are, inter alia, board structure variables (e.g. Bertoni et al., 2014), total risk factors (e.g. Abdou and Dicle, 2007), or the underwriter's reputation (e.g. Chen and Mohan, 2002). It cannot be ruled out that the unavailability of these variables causes a problem of omitted variables. Excluding variables with explanatory power may render *OLS* estimators biased and inconsistent, leading to a model with a lower *R-squared*, i.e. a lower explained proportion of the dependent variable's (*UP*) variance (Wooldridge, 2002). Finally, it should be noted that *SDC Platinum* cannot be considered exhaustive with respect to IPOs included in its database. There might be a pattern regarding IPOs that are missing from the database which could result in a distortion of the results obtained from the analyses in this paper.

Limitations of the Research Design

IFAs differ among each other with respect to the range of services offered, resources at their disposal, and the level of involvement in the day-to-day management of the IPO process. In Section 2.3.1, an attempt is made to define an IFA in a consistent manner based on unambiguous criteria to allow for a reliable measurement. Yet, depending on their respective characteristics and competencies, some IFAs might primarily focus their work on determining the right offer price, whereas others might emphasize other services, such as supporting the company in the selection of underwriters, or giving advice on the share allocation to investors. This variation could be reflected in the magnitude of their impact on underpricing.

It is also important to note that based on the analysis above no final conclusion can be drawn concerning the underlying causes of IFAs' effect on IPO pricing. While the hypotheses developed in this thesis are primarily based on the theory of information asymmetry between issuers and investment banks and the resulting moral hazard situation, other underpricing theories

could also be applicable. Most notably, IFAs could mitigate underpricing by certifying the quality of a company in the context of the signaling theory. To reliably determine the applicable theory, additional data, as for instance on the allocation of shares in the IPO would be required (Jenkinson et al., 2018). An observed higher quality of investors receiving shares in IPOs that involve an IFA would provide evidence in support of the agency conflict theory. Moreover, the lack of data concerning fees charged by IFAs does not permit a conclusion on the net benefit provided by IFAs, as marginal costs could exceed marginal benefits. In this context, it should also be noted that the services provided by IFAs are not limited to advising the company on the final offer price and share allocation (Section 2.3.2). As this paper focuses on the marginal benefits of IFAs related to IPO pricing, it excludes other potential benefits such as cost savings from more favorably negotiated underwriter fees, or other IFA services that are difficult to quantify.

Lastly, this paper has chosen an *OLS* regression model to examine the determinants of underpricing. An important assumption of an *OLS* estimation is the linearity between the dependent variable and its independent variables. Therefore, the estimated models in this thesis are not able to capture potential non-linear relationships. In order to ensure linear relationships, the natural logarithm has been applied to some of the independent variables. For other variables, the natural logarithm could not be applied (e.g. in case of binary variables), which can result in a misspecification in the case of non-linear relationships.

8. Conclusion and Future Research

Summary of the Main Results

This paper has analyzed the role of IFAs in the IPO process. As a comparatively new actor in the IPO market, IFAs emphasize their potential to mitigate the perceived conflict of interest between issuing companies and investment banks. Their argument is based on the theory of information asymmetry between issuers and underwriters in the context of underpricing: The importance of institutional clients for banks' revenues in combination with banks' superior information on the 'true' value of the company's shares places them in a situation of moral hazard. They are tempted to engage in a 'quid pro quo' by pushing for an offer price below the 'true' value and then lobby for a favorable share allocation on behalf of their institutional clients.

The first part of the analysis presented in this paper scrutinized IFAs' reasoning by empirically examining their impact on underpricing. The analyzed sample comprises 373 Western European IPOs conducted between January 2012 and February 2019, with an average underpricing of 7.2%. The potential mitigating effect of IFAs on underpricing was tested by applying both *OLS* and *WLS* regression models. The analyses revealed a statistically significant, (at the 5% level) and substantial mitigating effect of IFAs on underpricing. This effect was found to be robust when accounting for other controlling factors such as firm- and industry-specific effects. For the *Best Fitted Model*, the presence of an IFA in the IPO process reduced underpricing by approximately 3.4 percentage points which is equal to c. 8 million euros in additional proceeds raised for the average sample company.

In the second part of the analysis, the impact of IFAs on the accuracy of the offer price was examined. The reasoning behind this was that the results in the first part of the analysis could have been driven by a few incidences of considerable overpricing for IPOs that involved an IFA. As this scenario would be as undesirable as underpricing for firms, the second part of the analysis was necessary to establish that IFAs' effect on underpricing is in fact beneficial to companies. The prediction was that IFAs improve offer price accuracy and the results of both, a *Breusch-Pagan* and a *Variance Ratio Test*, each statistically significant at the 1% level, strongly supported this hypothesis. Combining the results of this two-part analysis, it can be concluded that IFAs have a beneficial impact on underpricing, as reflected by statistically significant test results. However, these findings do not necessarily imply a net benefit for companies from appointing an IFA, as associated costs were not incorporated in the statistical model. Based on the findings presented, the effect was found to be substantial as IFAs could on average charge a fee of up to 3.4% of proceeds raised and would still be beneficial to companies.

The final part of the analysis aimed to generate insights into what type of companies engage an IFA. Applying a binary response (*probit*) model, three firm characteristics were found to have significant effects on the likelihood to appoint an IFA: (i) The presence of a VC investor as shareholder prior to the IPO, (ii) the issuing company being affiliated with the financial industry, and (iii) the size of the issuing company. As suggested by experts interviewed (see Appendix F), the positive impact of VC investors on the likelihood to employ an IFA seems to be driven by VC's high level of financial sophistication. As they frequently exit investments through IPOs, VCs are more familiar with the complexities of the IPO process and thus attest more value to IFAs' services. The same reasoning is applied to explain the positive effect of companies affiliated with the financial industry. The finding that company size impacts the probability of IFA involvement can be interpreted as a consequence of IFAs' fee structure. This structure is likely to involve a decrease in the marginal costs of employing an IFA as the size of the IPO increases. An economic implication of this size effect is that companies below a certain size threshold may be excluded from the IFA market and its benefits.

To ensure the reliability of the paper's empirical results, several robustness tests were performed. When accounting for heteroscedasticity and the non-normality of the residuals, the significance of the results did not change. Moreover, employing winsorizing to the sample, no distorting effects of pre-winsorizing outliers were recognized. Finally, the findings' robustness was confirmed when using first week returns as an alternative measurement for underpricing.

However, despite these extensive robustness tests, several caveats remain. First, the size of the final sample limits the statistical power of the empirical results. Second, the manual collection of some of the data presented could have biased the findings due to human error. Third, some controlling variables that showed significant effects in previous literature (Butler et al., 2014) could not be included in the analyses due to a lack of availability, while others did not exhibit the effects predicted by previous literature (Table 8, Appendix B). Fourth, the focus on the mitigation of underpricing ignores other potential benefits that IFAs may provide, such as educating the company on the overall IPO process, and advising the issuer on the underwriter selection. Finally, no conclusion can be reached on whether the mitigating effect of IFAs on underpricing is based on an agency conflict between investment banks and issuing companies, or if a different explanation, as for instance the signaling theory, is applicable. Taken together, this means that even though the results presented in this paper can be considered reliable and informative, open questions still remain, and a fully conclusive evaluation of the role of IFAs in the IPO processes will only be possible after subsequent research has been conducted.

Concluding Remarks on Future Research

This is the first paper that empirically investigates the role of IFAs in the IPO process, contributing to the already existing research on IPOs and underpricing in a considerable number of ways: (i) It establishes a significant, mitigating influence of IFAs on underpricing that provides a basis for future research to build upon. (ii) Due to its significant impact, the presence of IFAs should be taken into account as a controlling variable when examining the effects of other factors on IPO underpricing. (iii) The results have practical relevance as they support IFAs' claim on their ability to mitigate issuing firms' agency conflicts with investment banks. (iv) The company size effect has important economic implications as it means that firms below a certain size threshold are essentially excluded from the IFA market and its potential benefits.

Given the novelty of this topic, the findings presented in this paper should be viewed as an important first step towards analyzing the role of IFAs in the IPO processes. Yet, many open questions remain, warranting future research. While the scope of this paper only permitted a focus on one potential benefit of engaging an IFA, the experts interviewed argued that the range of IFA services is more comprehensive. One potential topic for future analyses is, for example, the relationship between IFAs and investment banks during the IPO process. In this regard, valuable insights could be gained from investigating whether more reputable investment banks are chosen when IFAs weigh in on the selection process. This would confirm that IFAs have also a significant impact in the early phase of the IPO process.

Moreover, it could be explored whether fees paid to investment banks are lower and different in structure when IFAs are involved in the negotiation of these fees. Another potential research topic would be to examine whether 'investor quality' is improved when IFAs advise the company in the share allocation process. Studies with such focus could add to the findings of this paper by establishing to what extent IFAs' mitigating impact is founded in the agency conflict between investment banks and IPO companies. Finally, potential long-term effects of IFAs with respect to companies' post-IPO performances and the rate of de-listings could be explored.

The quote stated in the introduction of this paper (Section 1) alludes to the controversy of IFAs' role in the IPO process. Contrary to the opinion of the cited fund manager, this papers' analyses suggest that IFAs do in fact contribute *"more than what banks would offer companies otherwise."*, an important finding that is not only of practical relevance but that provides a promising foundation for future research.

9. References

Abdou, K. & Dicle, M.F. 2007, "Do risk factors matter in the IPO valuation?", *Journal of Financial Regulation and Compliance*, vol. 15, no. 1, pp. 63-89.

Abrahamson, M., Jenkinson, T. & Jones, H. 2011, "Why Don't U.S. Issuers Demand European Fees for IPOs?", *The Journal of Finance*, vol. 66, no. 6, pp. 2055-2082.

Aggarwal, R. 2000, "Stabilization Activities by Underwriters after Initial Public Offerings", *The Journal of Finance*, vol. 55, no. 3, pp. 1075-1103.

Aggarwal, R. 2003, "Allocation of Initial Public Offerings and Flipping Activity", *Journal of Financial Economics*, vol. 68, no. 1, pp. 111-135.

Aggarwal, R., Prabhala, N.R. & Puri, M. 2002, "Institutional Allocation in Initial Public Offerings: Empirical Evidence", *The Journal of Finance*, vol. 57, no. 3, pp. 1421-1442.

Agnew, H. & Massoudi, A. 2014, "Independent advisers ride IPO wave", *Financial Times* June 25, 2014, article can be found on: https://www.ft.com/content/7bfec082-fbbb-11e3-9a03-00144feab7de (last access: 09.05.2019).

Akerlof, G.A. 1970, "The Market for "Lemons": Quality Uncertainty and The Market Mechanism", *The Quarterly Journal of Economics*, vol. 84, no. 3, pp. 488-500.

Alin, A. 2010, "Multicollinearity", *Wiley Interdisciplinary Reviews: Computational Statistics*, vol. 2, no. 3, pp. 370-374.

Allen, F. & Faulhaber, G.R. 1989, "Signalling by underpricing in the IPO market", *Journal of Financial Economics*, vol. 23, no. 2, pp. 303-323.

Arugaslan, O., Cook, D.O. & Kieschnick, R. 2004, "Monitoring as a Motivation for IPO Underpricing", *The Journal of Finance*, vol. 59, no. 5, pp. 2403-2420.

Arulampalam, W. 1999, "A Note on Estimated Coefficients in Random Effects Probit Models", *Oxford Bulletin of Economics and Statistics*, vol. 61, no. 4, pp. 597-602.

Aussenegg, W., Stomper, A. & Pichler, P. 2006, "IPO Pricing with Bookbuilding and a When-Issued Market", *Journal of Financial and Quantitative Analysis*, vol. 41, pp. 829-862.

Baron, D.P. 1982, "A Model of the Demand for Investment Banking Advising and Distribution Services for New Issues", *The Journal of Finance*, vol. 37, no. 4, pp. 955-976.

Baron, D.P. & Holmström, B. 1980, "The Investment Banking Contract For New Issues Under Asymmetric Information: Delegation And The Incentive Problem", *The Journal of Finance*, vol. 35, no. 5, pp. 1115-1138.

Barry, C.B. 1994, "New Directions in Research on Venture Capital Finance", *Financial Management*, vol. 23, no. 3, pp. 3-15.

Barry, C.B. & Mihov, V.T. 2015, "Debt financing, venture capital, and the performance of initial public offerings", *Journal of Banking & Finance*, vol. 58, pp. 144-165.

Beatty, R.P. & Ritter, J.R. 1986, "Investment banking, reputation, and the underpricing of initial public offerings", *Journal of Financial Economics*, vol. 15, no. 1, pp. 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*, vol. 24, no. 2, pp. 343-361.

Benveniste, L.M. & Wilhelm, W.J. 1990, "A comparative analysis of IPO proceeds under alternative regulatory environments", *Journal of Financial Economics*, vol. 28, no. 1, pp. 173-207.

Bergström, C., Nilsson, D. & Wahlberg, M. 2006, "Underpricing and long-run performance patterns of european private-equity-backed and non-private-equity-backed IPOs.", *The Journal of Private Equity*, vol. 9, no. 4, pp. 16-47.

Bertoni, F., Meoli, M. & Vismara, S. 2014, "Board Independence, Ownership Structure and the Valuation of IPOs in Continental Europe", *Corporate Governance: An International Review*, vol. 22, no. 2, pp. 116-131.

Booth, J.R. & Smith, R.L. 1986, "Capital raising, underwriting and the certification hypothesis", *Journal of Financial Economics*, vol. 15, no. 1, pp. 261-281.

Boulton, T.J., Smart, S.B. & Zutter, C.J. 2010, "IPO underpricing and international corporate governance", *Journal of International Business Studies*, vol. 41, no. 2, pp. 206-222.

Brau, J.C. & Fawcett, S.E. 2006, "Initial Public Offerings: An Analysis of Theory and Practice", *The Journal of Finance*, vol. 61, no. 1, pp. 399-436.

Burgess, K. 2014, "Rothschild first among equals in independent equity advice", *Financial Times* February 27, 2014, article can be found on: https://www.ft.com/content/614e8f86-9fa6-11e3-b6c7-00144feab7de (last access: 09.05.2019).

Busaba, W.Y. & Chang, C. 2010, "Bookbuilding vs. fixed price revisited: The effect of aftermarket trading", *Journal of Corporate Finance*, vol. 16, no. 3, pp. 370-381.

Butler, A., Keefe, M. & Kieschnick, R. 2014, "Robust Determinants of IPO Underpricing and Their Implications for IPO Research", *Journal of Corporate Finance*, vol. 27, pp. 367-383.

Carlson, W.L., Newbold, P. & Thorne, B.M. 2013, "Statistics for Business and Economics", 8th edition, Pearson Education, Edinburgh.

Carter, R. & Manaster, S. 1990, "Initial Public Offerings and Underwriter Reputation", *The Journal of Finance*, vol. 45, no. 4, pp. 1045-1067.

Chemmanur, T.J., Hu, G. & Huang, J. 2010, "The Role of Institutional Investors in Initial Public Offerings", *The Review of Financial Studies*, vol. 23, no. 12, pp. 4496-4540.

Chen, C.R. & Mohan, N.J. 2002, "Underwriter Spread, Underwriter Reputation, and IPO Underpricing: A Simultaneous Equation Analysis", *Journal of Business Finance & Accounting,* vol. 29, no. 3, pp. 521-540.

Cliff, M.T. & Denis, D.J. 2004, "Do Initial Public Offering Firms Purchase Analyst Coverage with Underpricing?", *The Journal of Finance,* vol. 59, no. 6, pp. 2871-2901.

Cornelli, F. & Goldreich, D. 2001, "Bookbuilding and Strategic Allocation", *The Journal of Finance,* vol. 56, no. 6, pp. 2337-2369.

Cornelli, F. & Goldreich, D. 2003, "Bookbuilding: How Informative Is the Order Book?", *The Journal of Finance,* vol. 58, no. 4, pp. 1415-1443.

Corwin, S.A. & Schultz, P. 2005, "The Role of IPO Underwriting Syndicates: Pricing, Information Production, and Underwriter Competition", *The Journal of Finance,* vol. 60, no. 1, pp. 443-486.

Daily, C.M., Trevis Certo, S., Dalton, D.R. & Roengpitya, R. 2003, "IPO Underpricing: A Meta–Analysis and Research Synthesis", *Entrepreneurship Theory and Practice,* vol. 27, no. 3, pp. 271-295.

Davidson III, W.N., Xie, B. & Xu, W. 2006, "IPO Placement Risk and the Number of Co-Managers", *Financial Review,* vol. 41, no. 3, pp. 405-418.

Dolvin, S.D. & Kirby, J.E. 2016, "The Impact of Board Structure on IPO Underpricing", *The Journal of Private Equity,* vol. 19, no. 2, pp. 15-21.

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,* vol. 55, no. 3, pp. 1039-1074.

Gajewski, J. & Gresse, C. 2006, "A Survey of the European IPO Market ", *European Capital Markets Institute,* no. 2.

Goldstein, M.A., Irvine, P. & Puckett, A. 2011, "Purchasing IPOs with Commissions", *Journal of Financial and Quantitative Analysis,* vol. 46, no. 5, pp. 1193-1225.

Grinblatt, M. & Hwang, C.Y. 1989, "Signalling and the Pricing of New Issues", *The Journal of Finance,* vol. 44, no. 2, pp. 393-420.

Gujarati, D.N. & Porter, D.C., 2009, "Basic econometrics", 6th edition, McGraw-Hill Irwin, Boston.

Habib, M.A. & Ljungqvist, A.P. 2001, "Underpricing and Entrepreneurial Wealth Losses in IPOs: Theory and Evidence", *The Review of Financial Studies,* vol. 14, no. 2, pp. 433-458.

Hanley, K.W. 1993, "The underpricing of initial public offerings and the partial adjustment phenomenon", *Journal of Financial Economics,* vol. 34, no. 2, pp. 231-250.

Hanley, K.W. 2017, "The Economics of Primary Markets", *Working Paper,* Lehigh University, Available at SSRN: https://ssrn.com/abstract=3046256.

Hanley, K.W. & Wilhelm, W.J. 1995, "Evidence on the strategic allocation of initial public offerings", *Journal of Financial Economics,* vol. 37, no. 2, pp. 239-257.

Hu, W.Y. & Ritter, J.R. 2007, "Multiple bookrunners in IPOs", *Unpublished Working Paper*, University of Florida.

Ibbotson, R.G. 1975, "Price performance of common stock new issues", *Journal of Financial Economics,* vol. 2, no. 3, pp. 235-272.

Jegadeesh, N., Weinstein, M. & Welch, I. 1993, "An empirical investigation of IPO returns and subsequent equity offerings", *Journal of Financial Economics,* vol. 34, no. 2, pp. 153-175.

Jenkinson, T. & Jones, H. 2004, "Bids and Allocations in European IPO Bookbuilding", *The Journal of Finance,* vol. 59, no. 5, pp. 2309-2338.

Jenkinson, T. & Jones, H. 2009a, "Competitive IPOs", *European Financial Management,* vol. 15, no. 4, pp. 733-756.

Jenkinson, T. & Jones, H. 2009b, "IPO Pricing and Allocation: A Survey of the Views of Institutional Investors", *The Review of Financial Studies,* vol. 22, no. 4, pp. 1477-1504.

Jenkinson, T., Jones, H. & Suntheim, F. 2018, "Quid Pro Quo? What Factors Influence IPO Allocations to Investors?", *The Journal of Finance,* vol. 73, no. 5, pp. 2303-2341.

Jenkinson, T., Morrison, A.D. & Wilhelm, W.J. 2006, "Why are European IPOs so rarely priced outside the indicative price range?", *Journal of Financial Economics,* vol. 80, no. 1, pp. 185-209.

Klein, A. 1996, "Can investors use the prospectuses to price initial public offerings?", *The Journal of Financial Statement Analysis*, vol. 2, pp. 23-39.

Krigman, L., Shaw, W.H. & Womack, K.L. 2001, "Why do firms switch underwriters?", *Journal of Financial Economics,* vol. 60, no. 2, pp. 245-284.

Lee, P.M. & Wahal, S. 2004, "Grandstanding, certification and the underpricing of venture capital backed IPOs", *Journal of Financial Economics,* vol. 73, no. 2, pp. 375-407.

Li, M., McInish, T.H. & Wongchoti, U. 2005, "Asymmetric Information in the IPO Aftermarket", *Financial Review,* vol. 40, no. 2, pp. 131-153.

Liu, X. & Ritter, J.R. 2010, "The Economic Consequences of IPO Spinning", *The Review of Financial Studies,* vol. 23, no. 5, pp. 2024-2059.

Ljungqvist, A. 2007, "Chapter 7 - IPO Underpricing", *Handbook of Empirical Corporate Finance SET,* pp. 375-422.

Ljungqvist, A. & Wilhelm Jr., W.J. 2003, "IPO Pricing in the Dot-com Bubble", *The Journal of Finance,* vol. 58, no. 2, pp. 723-752.

Logue, D.E. 1973, "On the Pricing of Unseasoned Equity Issues: 1965–1969", *Journal of Financial and Quantitative Analysis,* vol. 8, no. 1, pp. 91-103.

Loughran, T. & Ritter, J.R. 2002, "Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs?", *The Review of Financial Studies*, vol. 15, no. 2, pp. 413-444.

Loughran, T. & Ritter, J.R. 2004, "Why Has IPO Underpricing Changed over Time?", *Financial Management*, vol. 33, no. 3, pp. 5-37.

Loughran, T., Ritter, J.R. & Rydqvist, K. 1994, "Initial public offerings: International insights", *Pacific-Basin Finance Journal*, vol. 2, no. 2, pp. 165-199.

Loughran, T., Ritter, J.R. & Rydqvist, K. 2019, updated version from March 6, 2019 of 1994 "Initial public offerings: International insights", *Pacific-Basin Finance Journal*, vol. 2, no. 2, pp. 165-199, Retrieved from https://site.warrington.ufl.edu/ritter/ipo-data/ (last access: 09.05.2019).

Lowry, M., Michaely, R. & Volkova, E. 2017, "Initial Public Offerings: A Synthesis of the Literature and Directions for Future Research", *Foundations and Trends in Finance*, vol. 11, no. 3-4, pp. 154-320.

Lowry, M. & Murphy, K.J. 2007, "Executive stock options and IPO underpricing", *Journal of Financial Economics*, vol. 85, no. 1, pp. 39-65.

Lowry, M. & Schwert, G.W. 2004, "Is the IPO pricing process efficient?", *Journal of Financial Economics*, vol. 71, no. 1, pp. 3-26.

Lu, X. & White, H. 2014, "Robustness checks and robustness tests in applied economics", *Journal of Econometrics*, vol. 178, pp. 194-206.

Masters, B. 2014, "Less can be more when adding up IPO advisers", *Financial Times* July 14, 2014, article can be found on: https://www.ft.com/content/b50eb556-0b5d-11e4-9e55-00144feabdc0 (last access: 09.05.2019).

Megginson, W.L. & Weiss, K.A. 1991, "Venture Capitalist Certification in Initial Public Offerings", *The Journal of Finance*, vol. 46, no. 3, pp. 879-903.

Mendoza, J.M. 2008, "Securities Regulation in Low-Tier Listing Venues: The Rise of the Alternative Investment Market", *Fordham Journal of Corporate & Financial Law*, vol. 13, no. 2, pp. 257-328.

Michaely, R. & Shaw, W.H. 1994, "The Pricing of Initial Public Offerings: Tests of Adverse-Selection and Signaling Theories", *The Review of Financial Studies*, vol. 7, no. 2, pp. 279-319.

Mogilevsky, V. & Murgulov, Z. 2012, "Underpricing of Private Equity-backed, Venture Capital-backed and Non-Sponsored IPOs", *Investment Management and Financial Innovations*, vol. 9, pp. 47-59.

Muscarella, C. & Vetsuypens, M. 1990, "Firm Age, Uncertainty, and IPO Underpricing: Some New Empirical Evidence", *SMU Working Paper*, Southern Methodist University.

Pastor, L. & Veronesi, P. 2005, "Rational IPO Waves", *The Journal of Finance*, vol. 60, no. 4, pp. 1713-1757.

Pulliam, S. & Smith, R. 2001, "CSFB official set quota for repayment of IPO profits in form of commissions", *Wall Street Journal* August 10, C1, article can be found on: https://www.wsj.com/articles/SB99738331566535405 (last access: 09.05.2019).

Reilly, F.K. & Hatfield, K. 1969, "Investor Experience with New Stock Issues", *Financial Analysts Journal*, vol. 25, no. 5, pp. 73-80.

Reuter, J. 2006, "Are IPO Allocations for Sale? Evidence from Mutual Funds", *The Journal of Finance*, vol. 61, no. 5, pp. 2289-2324.

Ritter, J.R. 1984, "The "Hot Issue" Market of 1980", *The Journal of Business*, vol. 57, no. 2, pp. 215-240.

Ritter, J.R. & Welch, I. 2002, "A Review of IPO Activity, Pricing, and Allocations", *The Journal of Finance*, vol. 57, no. 4, pp. 1795-1828.

Rock, K. 1986, "Why new issues are underpriced", *Journal of Financial Economics*, vol. 15, no. 1, pp. 187-212.

Schenone, C. 2004, "The Effect of Banking Relationships on the Firm's IPO Underpricing", *The Journal of Finance*, vol. 59, no. 6, pp. 2903-2958.

Schuster, J.A. 2003, "IPOs: insights from seven European countries", *Discussion paper 461*, London School of Economics.

Spatt, C. & Srivastava, S. 1991, "Preplay Communication, Participation Restrictions, and Efficiency in Initial Public Offerings", *The Review of Financial Studies*, vol. 4, no. 4, pp. 709-726.

Stoll, H.R. & Curley, A.J. 1970, "Small Business and the New Issues Market for Equities", *Journal of Financial and Quantitative Analysis*, vol. 5, no. 3, pp. 309-322.

Titman, S. & Trueman, B. 1986, "Information quality and the valuation of new issues", *Journal of Accounting and Economics*, vol. 8, no. 2, pp. 159-172.

Torstila, S. 2001, "The Distribution of Fees within the IPO Syndicate", *Financial Management*, vol. 30, no. 4, pp. 25-43.

van den Assem, M.J., van der Sar, N.L. & Versijp, P. 2017, "CEOs and CFOs on IPOs: The Process and Success of Going Public", *De Economist*, vol. 165, pp. 381-410.

Welch, I. 1989, "Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings", *The Journal of Finance*, vol. 44, no. 2, pp. 421-449.

Wooldridge, J.M. 2002, "Econometric Analysis of Cross Section and Panel Data", MIT Press, Cambridge.

Wooldridge, J.M. 2012, "Introductory econometrics: a modern approach", 5th edition, South-Western Cengage Learning, Mason OH.

Yung, C., Çolak, G. & Wang, W. 2008, "Cycles in the IPO market", *Journal of Financial Economics*, vol. 89, no. 1, pp. 192-208.

10. Appendices

Appendix A: Sample Description

Table 7: Sample Data Clustered by Industry

The table below shows the final sample of 373 Western European IPOs from the years 2012-2019 by their principal industry classification. The industry classification is derived from the specifications as provided in the SDC Platinum database.

	Year IPO								
Industry	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Co-generation	-	1	1	-	-	2	2	-	**6**
Commercial Bank	-	-	1	-	-	2	2	-	**5**
Construction	-	-	-	2	3	6	-	-	**11**
Credit Inst.	-	1	-	1	-	1	2	-	**5**
Electric Service	-	1	-	-	-	-	-	-	**1**
Healthcare	-	-	4	2	3	1	1	-	**11**
Insurance	1	2	4	2	-	-	-	-	**9**
Investment Bank	1	1	1	4	1	5	5	-	**18**
Leisure	1	1	-	1	2	1	-	-	**6**
Manufacturing	4	12	27	18	17	25	15	1	**119**
Mortgage Bank	-	-	1	-	-	-	-	-	**1**
Mtg Securities	-	1	-	-	-	-	-	-	**1**
Natural Resource	1	1	2	1	3	-	5	-	**13**
Other Finance	-	-	1	9	3	4	5	-	**22**
Other Services	-	-	1	-	-	2	2	-	**5**
Pers/Bus/Rep Svc	1	3	17	15	3	20	14	2	**75**
Radio/TV/Telecom	1	1	1	-	1	-	1	-	**5**
Real Estate	-	-	1	4	-	1	-	-	**6**
Restaurant/Hotel	-	1	4	2	1	1	-	-	**9**
Retail	1	1	9	3	4	3	3	-	**24**
Sanitation	-	1	-	1	-	-	-	-	**2**
Telephone Communication	1	-	3	-	-	-	2	-	**6**
Transportation	-	2	1	1	-	2	3	-	**9**
Wholesale	-	-	2	-	1	1	-	-	**4**
Total	**12**	**30**	**81**	**66**	**42**	**77**	**62**	**3**	**373**

Appendix B: Explanation and Descriptive Statistics of Regression Variables

Table 8: Variable Explanations

The table below gives a short description of all variables used in the regression models estimated above. It also provides the expected effect on the dependent variable UP based on previous academic literature, and the respective source of the data used to create the variable.

Variable Name	Description	Expected Effect	Source
FirmAge	The variable *FirmAge* measures the age of a company at the IPO date. In line with Butler et al. (2014), the variable is calculated by first adding +1 to the age of the company in years at the IPO date and then applying a logarithmic transformation: $$FirmAge = LN(1 + Firm\ age\ of\ the\ company\ at\ IPO)$$ Muscarella and Vetsuypens (1990) note that *FirmAge* is a proxy for ex-ante uncertainty caused by the difficulty of valuing a company. It is assumed that companies with a longer operating history provide more information to investors that can be used to value the company. Consistent with this theory, Carter and Manaster (1990), as well as Li et al. (2005) show that firm age has a negative effect on the level of underpricing.	Mitigates underpricing	Manually collected from IPO prospectus
Bookrunners	*Bookrunners* is a binary variable that equals 1 if an IPO was executed by multiple (i.e. more than one) bookrunners and 0 otherwise. Hu and Ritter (2007) argue that multiple bookrunners, compared to a single bookrunner, benefit issuing companies in two ways: (i) the company's bargaining power increases and (ii) information production during the bookbuilding process improves. Both effects are expected to mitigate underpricing. In line with Butler et al. (2014), a binary transformation is used instead of a discrete variable.	Mitigates underpricing	*SDC Platinum*
VC	*VC* is a binary variable that equals 1 if the company had a Venture Capital investor (VC) as shareholder prior to the IPO and 0 otherwise. According to Megginson and Weiss (1991), IPOs backed by a VC experience significantly lower mean and median underpricing. Dolvin and Kirby (2016) corroborate these results. Both argue that VCs can certify an issuing company's quality, thereby mitigating information asymmetry and consequently underpricing. The signal is credible since VCs have a high incentive to protect their long-term reputation with investors and since they are frequently involved in IPOs.	Mitigates underpricing	*SDC Platinum*
PE	*PE* is a binary variable that equals 1 if the company had a Private Equity investor (PE) as shareholder prior to the IPO and 0 otherwise. Similar to *VC*'s effect, it is argued that PE investors certify the company's quality through their reputation. Both Bergström et al. (2006) and Mogilevsky and Murgulov (2012) find that PE has a mitigating effect on underpricing.	Mitigates underpricing	*SDC Platinum*
Tech	*Tech* is a binary variable that equals 1 if the issuing company belongs to the technological industry and 0 otherwise. Loughran and Ritter (2004) argue that companies in the technological sector are more difficult to value due to the nature of their business. In turn, IPOs of tech companies are associated with higher ex-ante uncertainty. Consequently, it is expected that companies belonging to this industry exhibit a higher level of underpricing. Assignment of companies to the tech industry was done based on the *SIC codes* provided by Loughran and Ritter (2004) and Davidson et al. (2006): Bio-Tech (2833 – 2836; 8731 – 8734),	Increases underpricing	Based on SIC codes in *SDC Platinum*

	Computer (3570 – 3577; 7370 – 7374), Electronics (3670 – 3674), Navigation Equipment (3812), Measuring and Controlling Devices (3823, 3825, 3826, 3827, 3829), Medical Instruments (3841, 3845), Telephone Equipment (4812, 4813), Communication Service (4899).		
Regulated	*Regulated* is a binary variable that equals 1 if the issuing company belongs to the regulated utility industry and 0 otherwise. Davidson et al. (2006) argue that, as opposed to tech companies, firms that belong to the utility industry are easier to value for investors and thus exhibit less underpricing. Assignment of companies to the regulated (utility) industry was done based on the SIC codes provided by Davidson et al. (2006): Utility (4900 – 4999).	Mitigates underpricing	Based on SIC codes in *SDC Platinum*
Financial	*Financial* is a binary variable that equals 1 if the issuing company belongs to the financial industry and 0 otherwise. As the financial industry is highly regulated, Davidson et al. (2006) argue that these companies exhibit lower ex-ante uncertainty. As a result, it is expected that IPOs of companies belonging to the financial industry are associated with lower levels of underpricing. Assignment of the companies was done based on the SIC codes provided by Davidson et al. (2006): Financial Institutions (6000 – 6999).	Mitigates underpricing	Based on SIC codes in *SDC Platinum*
Revenues	The variable *Revenues* serves as proxy to measure the size of a company. As noted by Ritter (1984), size plays an important role as companies that generate considerable revenues are likely easier to value for investors compared to those with limited or no operating history. This theory is supported by Arugaslan et al. (2004) who show that higher levels of revenues result, ceteris paribus, in reduced underpricing. A logarithmic transformation is applied in line with Butler et al. (2014): $$Revenues = LN(1 + Revenue\ in\ EUR\ m)$$ As the sample also contains companies with no revenues up until their issuing date, +1 is added to all revenues to avoid excluding them as data points for the estimation. Revenues used to calculate the variable for each company are the last twelve months revenues prior to issuance when available. Otherwise, the year-end revenues prior to the IPO are used.	Mitigates underpricing	Manually collected from IPO prospectus
Filing Price Revision (F/P Revision)	The bookbuilding phase is an important part of the IPO process to determine the offer price as it allows investors to reveal information about the company (Cornelli and Goldreich, 2001). According to Hanley (1993), investors have to be compensated through a 'partial adjustment', that is the issuance is intentionally underpriced. In consequence, an upward revision of the offer price compared to the initial filing price is expected to lead to a higher level of underpricing (Loughran and Ritter, 2002). Filing price revision is calculated by using the midpoint of the price range as included in the company's initial filings: $$F/P\ Revision = \frac{P_{offer} - Middle\ of\ Filing\ Range}{Middle\ of\ Filing\ Range} * 100$$	Increases underpricing	*SDC Platinum*
Total Long-term Debt to Assets Ratio	As shown by Schenone (2004), companies that have an established lending relationship with a bank prior to its IPO exhibit significantly less underpricing. This impact is due to (i) the lender certifying the quality of the company by its decision to lend money to it after having reviewed the financial information	Mitigates underpricing	Manually collected from IPO prospectus

	(signaling), and (ii) the ongoing monitoring role that lenders take during the period in which the debt is outstanding. As both of these factors lower the ex-ante uncertainty about the issuing company for investors, underpricing is mitigated. As in the paper of Barry and Mihov (2015), the long-term debt to total assets ratio is used as a proxy for this lending relationship.		
MktReturn	According to Lowry and Murphy (2007), the magnitude of underpricing tends to increase during a so-called 'bull market'. Lowry and Schwert (2004) note that overall stock market returns during the period prior to the IPO has a positive correlation with underpricing. Given the focus on European IPOs, the average daily return in the 30 days prior to the IPO of the Morgan Stanley Capital International (MSCI) Europe index is chosen as a proxy for market returns: $\bar{\mu}_t^{MSCI} = \frac{1}{30} \sum_{i\,=\,t-31}^{t-1} MSCI_i$ On the other hand, Beatty and Ritter (1986) argue that market movements hardly have a significant influence. Given an average underpricing of 7.2% in the sample compared to an average daily return of approximately 0.02% during the sample period, the impact of market returns on underpricing is expected to be insignificant for the sample period.	No effect	*Thomson Reuters Eikon*
Fixed Effects for Years: 2012 - 2019	To account for potential fixed effects related to different issuing years, a binary variable is included for each issuing year (2012-2019). As noted by Pastor and Veronesi (2005), IPOs are highly cyclical and certain waves such as the 'internet bubble' are characterized by particularly high levels of underpricing (Ljungqvist and Wilhelm, 2003). Yung et al. (2008) argue that increased underpricing during IPO waves is due to an increase in ex-ante uncertainty caused by an elevated number of lower quality firms going public. As the period analyzed in this sample is not characterized by a particular wave, it is not expected that time fixed effects are significant.	No effect	*SDC Platinum*
Fixed Effects for Stock Exchanges: Euronext, London AIM, London Stock Exchange, Nordic Exchange, Other Exchange	To account for potential fixed effects related to the respective stock exchange of IPOs in the sample of this paper, binary variables are included for the different exchanges that equal 1 if a company lists at a certain exchange and 0 otherwise. Such differences can relate to the when-issued markets (Aussenegg, 2006) or the unregulated status of the London AIM (Gajewski and Gresse, 2006). Thus, a distinction is made between the London Stock Exchange and its unregulated part, the London AIM. Furthermore, the different Euronext exchanges (Belgium, France, the Netherlands, and Portugal) are grouped together. *Nordic Exchange* entails listings in Denmark, Finland, Norway, and Sweden. Finally, *Other Exchange* contains all other listings countries in the sample (Austria, Germany, Iceland, Ireland, Italy, Luxembourg, Spain, Switzerland).	No effect	*SDC Platinum*

Table 9: Pairwise Correlation Matrix

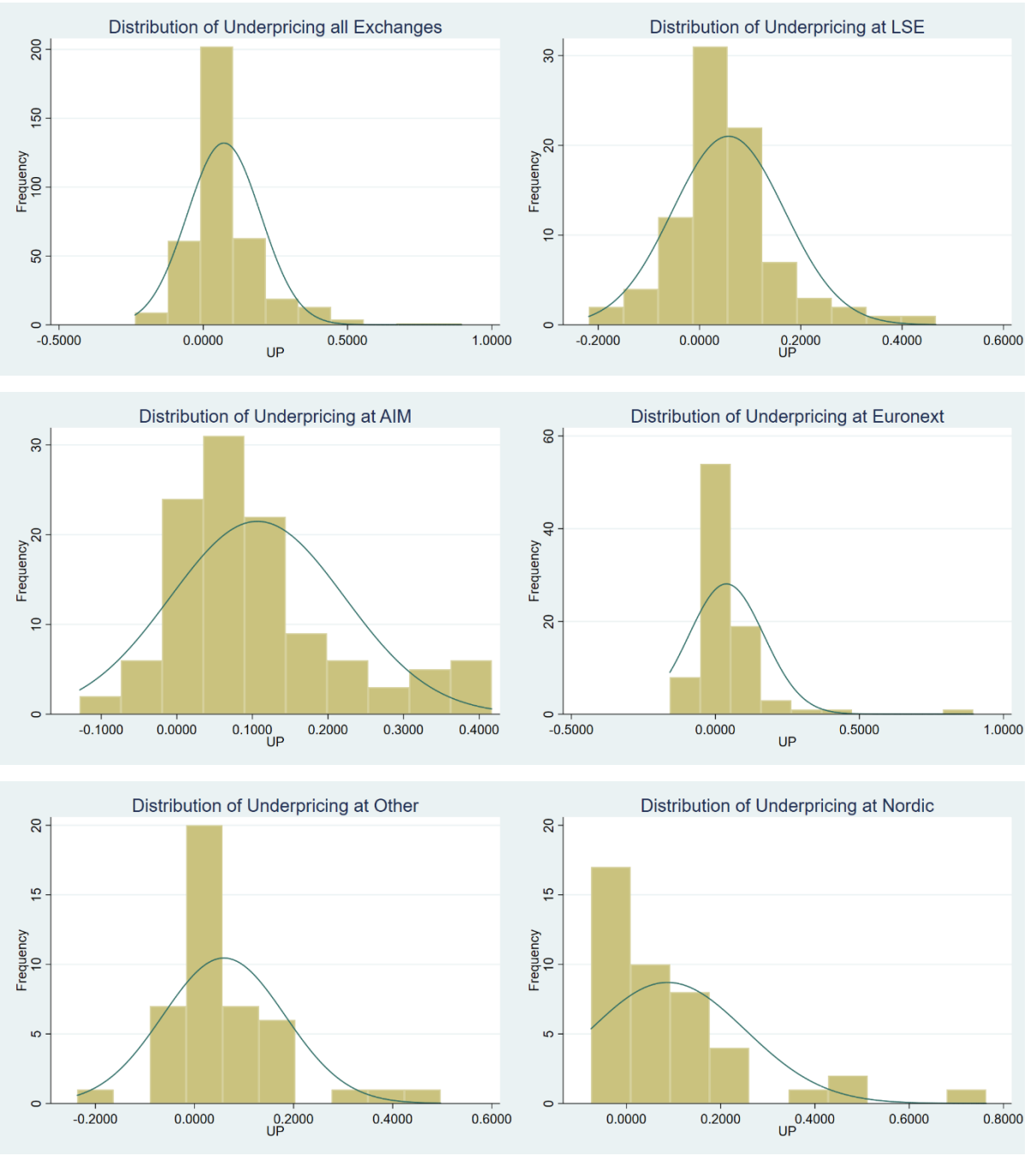
The table below shows the pairwise correlations of all variables used in the regression models above. The significance level of 5% is denoted by the asterisk.*

Variables	1	2	3	4	5	6	7	8	9	10	11
1 UP	1.00										
2 IFA	-0.15*	1.00									
3 Tech	-0.03	-0.07	1.00								
4 Regulated	-0.07	0.00	-0.06	1.00							
5 Financial	-0.02	0.07	-0.30*	-0.04	1.00						
6 FirmAge	0.11*	0.17*	-0.08	-0.03	-0.18*	1.00					
7 Revenues	0.04	0.32*	-0.34*	-0.04	-0.01	0.57*	1.00				
8 PE	-0.10	0.18*	-0.15*	0.05	-0.05	0.15*	0.37*	1.00			
9 VC	-0.11*	0.02	0.32*	0.05	-0.19*	-0.13*	-0.24*	-0.17*	1.00		
10 MktReturn	0.00	0.01	0.00	0.04	-0.05	0.01	0.14*	0.09	-0.03	1.00	
11 Bookrunners	-0.13*	0.31*	-0.03	0.02	0.02	0.07	0.36*	0.23*	0.08	0.07	1.00

Appendix C: Summary Statistics of the Dependent Variable Underpricing

Figure 5: Distribution of Underpricing – Overall Sample and Per Stock Exchange

The figure below shows the histograms of underpricing observed on the first trading day for the overall final sample and separately for each of the stock exchange (clusters). The green line outlines a normal distribution.



Appendix D: Statistical Analysis

Table 10: Overview of Statistical Tests Conducted and Their Respective Results

The table below summarizes the most important tests that have been conducted within the scope of this paper together with their respective null hypothesis, alternative hypotheses and respective p-values in parentheses behind H_a. The last column of the table gives a short description and interpretation of the respective test results.

Conducted Test	Null Hypothesis	Alternative hypotheses; (p-value)	Result/ Interpretation
One-sample t-test on first day initial returns (entire final sample)	H_0: mean(UP) = 0	• H_a: mean(UP) < 0; (1.0000) • H_a: mean(UP) ≠ 0; (0.0000) • H_a: mean(UP) > 0; (0.0000)	**Significant underpricing** in entire final sample
One-sample t-test on first day initial returns (subsample IFA=0)	H_0: mean(UP) = 0	• H_a: mean(UP) < 0; (1.0000) • H_a: mean(UP) ≠ 0; (0.0000) • H_a: mean(UP) > 0; (0.0000)	**Significant underpricing** in subsample IFA=0
One-sample t-test on first day initial returns (subsample IFA=1)	H_0: mean(UP) = 0	• H_a: mean(UP) < 0; (1.0000) • H_a: mean(UP) ≠ 0; (0.0000) • H_a: mean(UP) > 0; (0.0000)	**Significant underpricing** in subsample IFA=1
Two-sample t-test with equal variances on the significance of mean differences of first day initial returns between the two subsamples (IFA=0 vs. IFA=1)	H_0: mean[UP| IFA=0] - mean[UP| IFA=1] = 0	• H_a: difference < 0; (0.9975) • H_a: difference ≠ 0; (0.0051) • H_a: difference > 0; (0.0025)	**Underpricing significantly lower for** the **subsample IFA=1** (vs. IFA=0)
Two-sample t-test with unequal variances on the significance of mean differences of first day initial returns between the two subsamples (IFA=0 vs. IFA=1)	H_0: mean[UP| IFA=0] - mean[UP | IFA=1] = 0	• H_a: difference < 0; (0.9991) • H_a: difference ≠ 0; (0.0018) • H_a: difference > 0; (0.0009)	**Underpricing significantly lower for** the **subsample IFA=1** (vs. IFA=0)
Two-sample Wilcoxon rank-sum test on the significance of mean differences of first day initial returns between the two subsamples (IFA=0 vs. IFA=1)	H_0: UP(IFA=0) = UP(IFA=1)	• H_a: UP(IFA=0) ≠ UP(IFA=1); (0.0047)	**Underpricing significantly different between** the two **subsamples** (IFA=1 vs. IFA=0)
Breusch-Pagan Test for the *Best Fitted OLS Model*	H_0: Constant variance	• H_a: Heteroscedasticity; (0.0007)	**Significant heteroscedasticity** for *Best Fitted OLS*
Variance Ratio Test on the significance of differences in the variance of first day initial returns between the two subsamples (IFA=0 vs. IFA=1)	H_0: sd[UP| IFA=0]/ sd[UP| IFA=1] = 1	• H_a: ratio < 1; (1.0000) • H_a: ratio ≠ 1; (0.0000) • H_a: ratio > 1; (0.0000)	**Standard deviation** (Sd) of underpricing **significantly lower for** the **subsample IFA=1** (vs. IFA=0)
Variance Inflation Factor (**VIF**): Test for multicollinearity in the Best Fitted OLS Model	Test provides VIFs. A VIF above 10 indicates strong multicollinearity	• Mean VIF: 1.11 • Maximum VIF: 1.16	**No issue of multicollinearity** as all VIFs substantially smaller than 10
Shapiro Wilk Test on the residuals of the Best Fitted OLS Model	H_0: Normal distribution of residuals	• H_a: Non-Normal distribution of residuals; (0.0000)	**Non-normal distribution** of **residuals**

Figure 6: Scatterplot of Fitted Values and Residuals of the Best Fitted OLS Model

The figure below displays the distribution of the residual errors for the OLS regression of the Best Fitted Model (see Table 3). The fitted values are plotted on the horizontal axis and the respective residuals on the vertical axis.

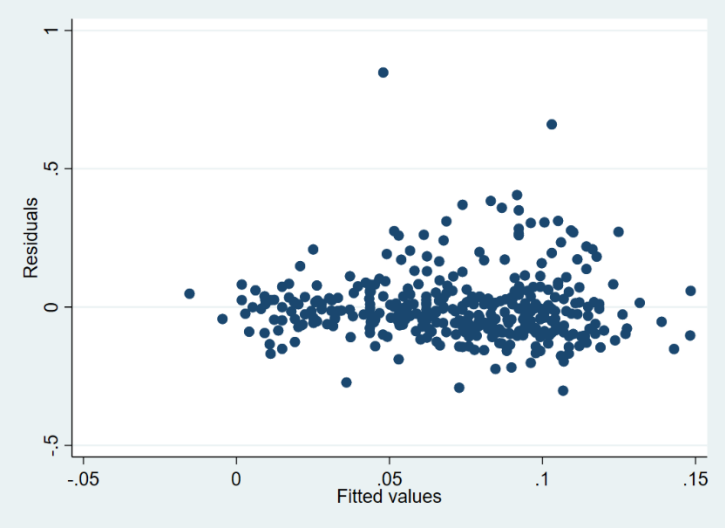
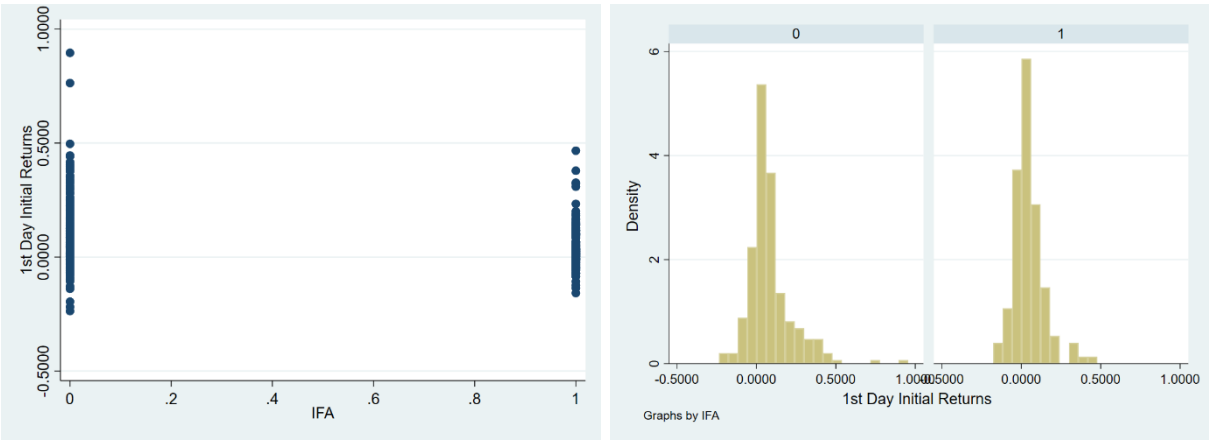


Figure 7: Distribution of First Day Initial Returns for Subsamples IFA=0 vs. IFA=1

The figure below shows on the left side the scatterplot between the dependent variable underpricing as measured by first day initial returns (vertical axis) and the study variable IFA (horizontal axis). On the right side, the histogram of first day initial returns is displayed for the two subsamples of the study variable (IFA=0 vs. IFA=1).



Appendix E: Robustness Checks

Figure 8: Histogram and Q-Q Normality Plot of Residuals of Best Fitted OLS Model

The figure below illustrates the histogram of the residuals of the Best Fitted OLS Model on the left side. On the right side, the Q-Q normality plot is depicted, which enables to examine whether the residuals are normally distributed. Deviations in the Q-Q normality plot from the diagonal line suggest divergence from normality.

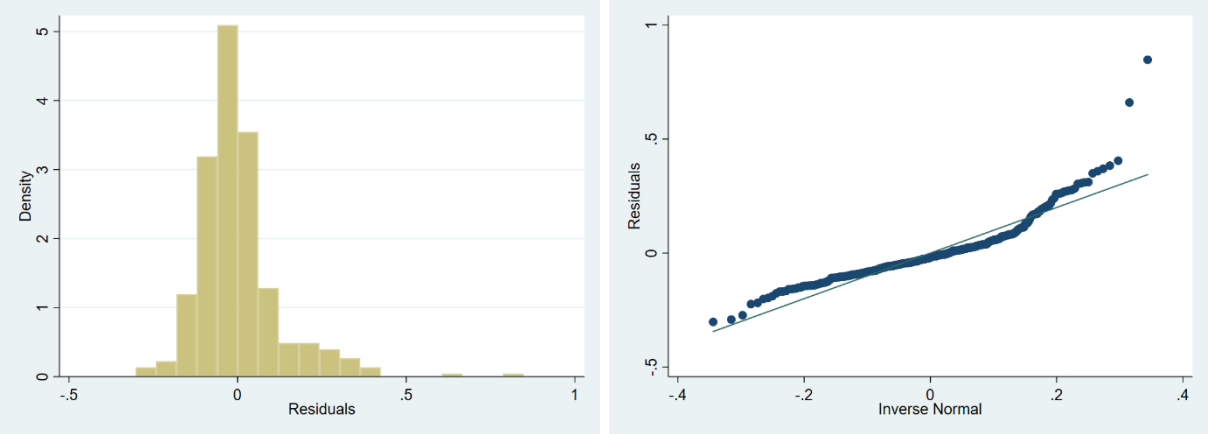


Table 11: Variance Inflation Factors of the Best Fitted OLS Model

The Variance Inflation Factor measures by how much the variation of a variable's coefficient increases as a result of collinearity. The VIFs are computed for the variables of the Best Fitted OLS Model (see Table 3). According to Alin (2010), a VIF above 10 indicates a strong presence of multicollinearity.

Variable	VIF	1/VIF
Bookrunners	1.16	0.860776
IFA	1.15	0.871933
PE	1.13	0.887378
VC	1.06	0.941068
FirmAge	1.06	0.942932
Mean VIF	**1.11**	

Adjusting for Heteroscedasticity – The Weighted Least Square (WLS) Procedure

The following section is based on Wooldridge (2012). For the *Best Fitted Model* defined in Section 5.2 to be considered efficient, a prerequisite is a constant variance (denoted as σ^2) of the error term *u* conditional on the independent variables henceforth denoted by vector $\boldsymbol{Z}$ (i.e. the assumption of homoscedasticity):

$$Var(u|\,\boldsymbol{Z}) = \sigma^2 \tag{9}$$

However, as shown in Section 5.3, the assumption of homoscedasticity does not hold for the *Best Fitted Model*, and thus the *Gauss-Markov Theorem* no longer applies. As a result, the *OLS* estimators for the coefficients β and γ_{1-4} can no longer be considered efficient and different estimation procedures can deliver more precise results. Within the scope of this paper, the *Weighted Least Squares* (*WLS*) procedure is applied and its concept described in the remainder of this section. As a first step, the variance has to be defined as a function (denoted by *h*) of the independent variables – given that it is no longer a constant:

$$Var(u|\,\boldsymbol{Z}) = \sigma^2 h(\boldsymbol{Z}) \tag{10}$$

Two cases have to be distinguished: (i) the exact functional form (i.e. function $h(\boldsymbol{Z})$ above) of the heteroscedasticity is known up to a multiplicative form, or (ii) the exact functional form is not known. The following explanation focuses on scenario (ii) as it is applicable within the scope of this thesis. Function $h(\boldsymbol{Z})$ is thus defined by the following functional form:

$$\mathrm{Var}(u|\,\mathbf{Z}) = \sigma^2 \exp(\boldsymbol{Z}'\boldsymbol{\delta}) \tag{11}$$

where $\boldsymbol{\delta}$ denotes a column vector of unknown parameters. While other functional forms of $h(\boldsymbol{Z})$ can be assumed, this particular specification was chosen as it is widely applied in econometrics literature (Wooldridge, 2012). A convenient advantage of this specification over linear functions is the fact that it ensures the positivity of predicted values – an important feature since the ultimately estimated variance must be positive by definition. Under the assumed form (11) of the variance, the squared error term u^2 can be defined as follows:

$$u^2 = \sigma^2 \exp(\boldsymbol{Z}'\boldsymbol{\delta})v \tag{12}$$

where *v* is defined as having a mean equal to unity (i.e. equal to 1), conditional on the independent variables $\boldsymbol{Z}$. Under the assumption that *v* is independent of $\boldsymbol{Z}$, the following equation can be stated:

$$\log(u^2) = \alpha_0 + \boldsymbol{Z}'\boldsymbol{\delta} + e \quad (13)$$

where *e* has a mean of zero and is independent of ***Z***. In practice, $\log(u^2)$ is derived in two steps: (i) the original *OLS* regression of the *Best Fitted Model* (Equation 6 in Section 5.2) is run to receive the estimated residuals $\hat{u}$. Next (ii), the estimated residuals $\hat{u}$ are squared and a log transformation applied to obtain $log(\hat{u}^2)$.

Subsequently, the transformed term $log(\hat{u}^2)$ is regressed on the independent variables ***Z***. This is done to obtain the fitted values of $log(\hat{u}^2)$, i.e. the values predicted by the estimated equation. These fitted values of $log(\hat{u}^2)$ are denoted by $\hat{g}_i$. Now the function *h*(***Z***) can be derived by exponentiating the fitted values $\hat{g}_i$:

$$\hat{h}_i = \exp(\hat{g}_i) \quad (14)$$

The estimated values $\hat{h}_i$ are then used to form the weights $\frac{1}{\sqrt{\hat{h}_i}}$ to be applied in the subsequent *Weighted Least Squares* (*WLS*) *procedure.*[25] To perform the *WLS* regression, both sides of the equation for the *Best Fitted Model* (Equation 6 in Section 5.2) are multiplied by the weight $\frac{1}{\sqrt{\hat{h}_i}}$ defined above:

$$\frac{UP_i}{\sqrt{\hat{h}_i}} = \frac{\alpha}{\sqrt{\hat{h}_i}} + \beta\frac{IFA_i}{\sqrt{\hat{h}_i}} + \gamma_1\frac{FirmAge_i}{\sqrt{\hat{h}_i}} + \gamma_2\frac{PE_i}{\sqrt{\hat{h}_i}} + \gamma_3\frac{VC_i}{\sqrt{\hat{h}_i}} + \gamma_4\frac{Bookrunners_i}{\sqrt{\hat{h}_i}} + \frac{u_i}{\sqrt{\hat{h}_i}} \quad (15)$$

This transformed Equation (15) is then used to re-estimate the coefficients β and γ_{1-4}, concluding the *WLS* procedure. The *WLS* estimators are a form of *General Least Squares* (*GLS*) estimators. The name is derived from the fact that the sum of the squared residuals $\sum_{i=1}^{n} u_i^2$ is first weighted by $\frac{1}{\sqrt{\hat{h}_i}}$ and subsequently minimized. Thus, the *WLS* estimation attaches more weight to observations that experience less variation. *OLS* is essentially just a special form of *GLS* that assumes equal weights for all observations. As highlighted above, *WLS* estimators are preferable in case of heteroscedasticity since they are more efficient than *OLS* estimators. While the *WLS* procedure produces new values for the standard errors and hence the t-statistics, the way of interpreting them remains the same as under *OLS*. The coefficient estimates are never identical for the two procedures. However, they should not be substantially different from each other (e.g. exhibit a change in sign for a coefficient) since a substantial difference could imply that the assumed function of heteroscedasticity is misspecified.

[25] The square root is taken as $\hat{h}_i$ is the estimation of squared residuals $\hat{u}^2$, whereas *WLS* relies on the non-squared residuals $\hat{u}$.

Table 12: Robustness Check – Winsorizing Outliers at the 5% and 95% Level

*The table below reports the outcome of the same OLS models as previously estimated in Section 5.2 (see Table 3) with winsorized (first day) underpricing data using cut-offs at 5% and 95%. Winsorizing the outliers, the minimum underpricing increases from -23.7% to -7.2% and the maximum underpricing decreases from +89.6% to +33.3%. While the median of the sample's underpricing must remain the same when winsorizing is applied, mean underpricing decreases from 7.2% to 6.9%. The robust standard errors for each variable obtained through the sandwich (robust covariance matrix) estimator are reported in parentheses. The significance level is denoted by asterisks at the ***(1%), **(5%) and *(10%) level.*

VARIABLES	(1) Bivariate Model	(2) Full Model	(3) Time Fixed Effects	(4) Exchange Fixed Effects	(5) Best Fitted Model
IFA	-0.0332***	-0.0306***	-0.0313***	-0.0242**	-0.0290***
	(0.0104)	(0.0106)	(0.0107)	(0.0112)	(0.0107)
Tech		0.00333	0.00608	0.00867	
		(0.0135)	(0.0136)	(0.0137)	
Regulated		-0.0685*	-0.0728*	-0.0537*	
		(0.0408)	(0.0410)	(0.0325)	
Financial		-0.000124	0.000736	-0.00191	
		(0.0145)	(0.0145)	(0.0149)	
NonEuropean		-0.0180	-0.0167	-0.0354*	
		(0.0198)	(0.0203)	(0.0207)	
FirmAge		0.0131***	0.0134***	0.0139***	0.0140***
		(0.00467)	(0.00482)	(0.00498)	(0.00351)
Revenues		0.00129	0.000683	0.00142	
		(0.00309)	(0.00310)	(0.00314)	
PE		-0.0309**	-0.0276*	-0.0296*	-0.0296**
		(0.0139)	(0.0155)	(0.0151)	(0.0127)
VC		-0.0344**	-0.0341*	-0.0177	-0.0351**
		(0.0166)	(0.0175)	(0.0172)	(0.0142)
Bookrunners		-0.0199	-0.0198	-5.72e-05	-0.0166
		(0.0123)	(0.0126)	(0.0130)	(0.0112)
MktReturn		0.293	1.322	-0.454	
		(3.519)	(3.762)	(3.537)	
Constant	0.0797***	0.0602***	0.0546*	0.0259	0.0595***
	(0.00689)	(0.0152)	(0.0315)	(0.0230)	(0.0115)
Observations	373	372	372	372	373
R-squared	0.023	0.087	0.101	0.117	0.078
Exchange				YES	
Year			YES		

Table 13: Robustness Check – OLS Regression with 1st Week Initial Returns

*The table reports the outcome of linear regression models with the same independent variables as in the main OLS regression models (see Table 3 of Section 5.2) but 1st Week Underpricing (UPweek) as the dependent variable. UPweek is defined as the percentage difference between the historical closing price on the last day of the first trading week and the offer price. As underpricing is expected to prevail until the end of the first trading week, the models tested serve as a robustness check for the impact of the study variable IFA on underpricing. The robust standard errors for each variable obtained through the sandwich (robust covariance matrix) estimator are reported in parentheses. The significance level is denoted by asterisks at the ***(1%), **(5%) and *(10%) level.*

VARIABLES	(1) Bivariate Model	(2) Full Model	(3) Time Fixed Effects	(4) Exchange Fixed Effects	(5) Best Fitted Model
IFA	-0.0470***	-0.0467***	-0.0478***	-0.0379**	-0.0435***
	(0.0154)	(0.0160)	(0.0161)	(0.0169)	(0.0162)
Tech		-0.00106	0.00409	0.00339	
		(0.0216)	(0.0214)	(0.0218)	
Regulated		-0.106***	-0.102**	-0.0957***	
		(0.0407)	(0.0451)	(0.0361)	
Financial		0.00384	0.00212	0.00493	
		(0.0215)	(0.0217)	(0.0223)	
NonEuropean		-0.0334	-0.0328	-0.0490	
		(0.0365)	(0.0367)	(0.0378)	
FirmAge		0.0165**	0.0162**	0.0159**	0.0183***
		(0.00700)	(0.00729)	(0.00745)	(0.00502)
Revenues		0.00241	0.00197	0.00364	
		(0.00544)	(0.00542)	(0.00558)	
PE		-0.0328*	-0.0290	-0.0346*	-0.0295*
		(0.0168)	(0.0193)	(0.0193)	(0.0151)
VC		-0.0165	-0.0207	-0.00872	-0.0217
		(0.0316)	(0.0323)	(0.0319)	(0.0294)
Bookrunners		-0.0270	-0.0247	-0.0109	-0.0208
		(0.0182)	(0.0186)	(0.0205)	(0.0174)
MktReturn		2.708	3.788	1.799	
		(7.152)	(7.411)	(7.283)	
Constant	0.101***	0.0719***	0.0712	0.0206	0.0701***
	(0.0116)	(0.0274)	(0.0485)	(0.0345)	(0.0197)
Observations	373	372	372	372	373
R-squared	0.018	0.053	0.067	0.064	0.044
Exchange				YES	
Year			YES		

Appendix F: Expert Interview

Below, a summary of an expert interview conducted with *Krister Sundling* and *Magnus Wärn* from the Independent Financial Advisory *Sundling Wärn Partners* is presented. This summary is based on an audio recording of that interview. In the interest of conciseness and relevance, only the key aspects of the interview are presented instead of a full transcript. The authors are aware that interviews with IFAs do not present a 'neutral' view of the topic analyzed in this paper. In consequence, any insights gained from this and other expert interviews that were incorporated in this paper were either empirically tested or clearly highlighted as hypotheses or potential explanations, but not presented as fact. Some information on the experts interviewed is provided at the end of the interview summary.

Question: In your opinion, is the engagement of financial advisors in IPOs a more recent trend and if so, what do you think is the cause for that?

The engagement of IFAs in the IPO process is a more recent phenomenon that has gained traction in the aftermath of the Global Financial Crisis. One potential reason is that in the wake of the crisis, financial professionals that left '*bulge bracket'* investment banks increasingly founded '*boutique'* investment banks. Previously working in *Equity Capital Markets* divisions, these professionals leveraged their experience by offering their advisory services independently from these '*bulge bracket*' investment banks.

Question: How would you describe a typical company that hires an IFA? Do you observe significant differences in characteristics such as their size, pre-IPO ownership or their industry classification?

Size is an important determinant. In Europe, IPOs with an offering size above 200 to 300 million euros are very likely to appoint an IFA. As size increases, so will the number of members in the syndicate, which in turn means that coordination is more complex. With respect to pre-IPO ownership, VC and PE ownership plays an important role. One reason for this is the positive correlation with size. Moreover, financial sophistication and the way PE and VC investors operate play a crucial role. PE and VC investors frequently deal with the complexities of different transactions such as IPOs and are therefore more aware of potential issues related to an IPO. In general, such investors also tend to appoint advisors for very narrow responsibilities, such as advisors on environmental, social and governmental issues (ESG), or an IFA for advice on an IPO. At the same time, most PE and VC investors probably do not conduct more than one IPO per year, so that it is very difficult to build in-house expertise similar to that of an IFA. On the

contrary, an entrepreneur, who takes his/her company public, often has an established long-term relationship with a particular bank and one or two 'confidants' such as a legal advisor that he or she trusts. Often times, such an owner might not see any obvious reason for hiring an IFA as it is the investment banks that take the company public at the end of the day. With respect to industry, we do not really see certain patterns.

Question: Do you notice any difference in IFA hiring rates with respect to different countries/ stock exchanges?

There could be a difference with respect to different countries that is related to the financial sophistication of the respective capital market. The capital market in the United Kingdom, for example, is very sophisticated and was the first where the role of IFAs started to emerge. For certain mandates, like privatizations of large companies, IFAs were involved in the process even before the last 10 years. In countries such as Germany, the Netherlands and the Nordics the role of IFAs has only gained traction in the last 10 years. Additionally, the participation of IFAs is also related to the sophistication of the PE and VC market in the respective country. Countries that have a very active PE and VC market offer more opportunities for IFAs.

Question: What is the fee structure of independent financial advisors like?

Some IFAs receive a retainer fee to ensure compensation even if the deal does not succeed. For other IFAs, the base fee is linked to the proceeds raised in the IPO. In addition to that, there is generally a discretionary fee that the company or the owners can decide to pay if they are satisfied with the provided services of the IFA and the outcome of the IPO. It is also important to note that fees are most likely independent of the type of transaction. That means, in case of a 'dual track' process, the IFA is not biased towards pushing for an IPO rather than for a sale of the company.

Question: At what stage(s) of the IPO process does an advisor get involved?

Ideally, we get involved two to three months before the underwriter selection process begins. That makes the most sense since it leaves sufficient time to prepare the company for the underwriter selection and allows us to weigh in on the selection. That being said, it can happen that the IFA only joins the process after the underwriter syndicate is already selected. At which stage an IFA gets involved does therefore vary from case to case.

Question: What do you consider the most important responsibilities/ tasks of an advisor?

One of many important tasks in the early stage of the process is educating the company on the IPO process and advising the firm on the selection of the investment banks. A key aspect of our

role is also to support the company in its fee negotiation with the banks. IFAs often also participate in the selection process of additional advisors, such as legal and PR advisors. During the IPO process, IFAs will participate in discussing the valuation of the company, its capital structure as well as finance-related similar topics. Generally, the closer the process gets to the effective date, the more involved the IFA becomes. Another important role is advising the issuing company on its investor selection and share allocation. Additionally, the final offer price is certainly an area where an IFA weighs in, as it is one of the key areas of the conflict of interest between investment banks and issuing companies. Sometimes, there can be a lot of mistrust in this area, especially when the effective day approaches. It is important to note that finding the offer price is something in which the IFA is involved throughout the process and not just at the very last day. The same is also true regarding the share allocation. In the interest of the issuing firm, an IFA will try to make sure that banks will not allocate too many shares to short-term oriented investors such as some hedge funds that won't hold on to the shares.

Question: Would you say that you mainly "take over" responsibilities otherwise carried out by investment banks/ owners/ issuing companies themselves, or that you rather fill out a "vacancy" in the process?

That depends to a large extend on the type of IFA. Very large IFAs might approach the role as a second global coordinator, whereas other IFAs approach the role by focusing on the issues in the process where the conflict of interest plays a role. To a large extent, this also depends on the respective transaction and the issuing company's owners. PE and VC investors want to be involved themselves to improve their own skills and knowledge in this area, so they prefer an IFA that is less 'hands-on'. In other deals, issuers may prefer to have all communication flow through the IFA, so that the IFA basically assumes the role of an intermediary. At the same time, if the IFA is too involved, there can be a potential issue of accountability when the deal does not succeed.

Question: Are you involved in the post-IPO phase?

Not to a large extent, but sometimes in the very narrow post-IPO phase. That means, for example, weighing in on the allocation of the investment banks' discretionary fee, or giving an opinion on potential price stabilization if the banks welcome that.

Question: Do banks generally perceive you as a threat to their business or as an additional layer of complexity in the deal, or rather as a helpful intermediary with the company that makes the process run smoother?

That differs from transaction to transaction. Sometimes banks do perceive IFAs as a 'hassle', but sometimes they are quite happy about IFA involvement, because they can lend credibility to an investment banks argument and help to convince the owners – provided that the IFA agrees with the investment banks' assessments. That being said, banks ultimately want to be the ones that run the process.

Question: Do you think that banks act differently in case of IFA presence in a transaction?

Absolutely. In the areas discussed above such as share allocation, investment banks will behave differently knowing that there is a third party that will weigh in if needed.

Question: From the viewpoint of issuing companies, is considerable underpricing perceived as an issue and thus something to avoid, or rather just as a cost associated with an IPO?

In Europe, it is not common for a company to intentionally underprice its shares for the purpose of the stock to considerably trade up after the IPO. This is related to the fact that in Europe usually a larger share of the ownership is sold in the IPO, making underpricing very undesirable for selling owners. So considerable underpricing would be perceived as giving away money.

Question: Do you think that appointing an IFA leads to the choice of a higher-quality underwriter? If yes, what do you consider as potential explanations? - Superior knowledge, superior connection, or other factors?

An IFA might be able to bring more objectivity to the process which could lead to a better outcome, since companies might otherwise simply pick the bank they know best or that they have an established relationship with. On smaller deals or in cases where the client does not know the country particularly well, IFAs might be able to add more value. For example, if an international client doesn't know which domestic banks the best relationships to institutional investors in the exchange country have, an IFA may leverage its local knowledge and provide valuable advice.

Some Information On the Experts Interviewed

Sundling Wärn Partners is an independent financial advisory firm founded in 2006 that primarily operates in the Nordic markets. Offering advice to owners, board of directors and management teams, the company is mainly active in the areas of equity capital markets advisory, corporate finance, and mergers and acquisitions.

The founders of *Sundling Wärn Partners*, *Krister Sundling* and *Magnus Wärn*, both have more than 25 years of financial advisory experience comprising public and private transactions in various industries involving both Nordic and non-Nordic clients. Prior to founding *Sundling Wärn Partners*, they have worked in investment banking at *Carnegie*, *Goldman Sachs*, *Handelsbanken*, and *Morgan Stanley*.

Appendix G: Overview of Sample Firms

Table 14: Overview of All IPOs Included in the Sample

The table below shows all firms included in the final sample of 373 Western European IPOs with their name, IPO date, Listing Market, and whether they employed an IFA during the IPO process.

Company	IPO Date	Listing Market	IFA at IPO process?
Ziggo NV	03.20.12	EuronextAM	No
Brunello Cucinelli SpA	04.23.12	Milan	No
Goldrooster AG	05.15.12	Frankfurt	No
Revolymer Plc	07.04.12	London AIM	No
Eland Oil & Gas PLC	09.03.12	London AIM	No
Talanx AG	10.01.12	Frankfurt	Yes
Borregaard ASA	10.18.12	Oslo	No
EFG Financial Products Holding	10.19.12	Swiss Exch	Yes
Hess AG	10.23.12	Frankfurt	No
Nanobiotix SA	10.23.12	Euro Paris	Yes
Telefonica Deutschland Holding	10.29.12	Frankfurt	No
Rangers International Football	12.19.12	London AIM	No
EAM Solar ASA	03.19.13	Oslo	No
Esure Group PLC	03.22.13	London	No
Moleskine SpA	03.28.13	Milan STAR	Yes
RTL Group SA	04.29.13	Luxembourg	Yes
Erytech Pharma SA	04.30.13	Euro Paris	No
Ymagis SA	04.30.13	Euro Paris	Yes
Lekoil Ltd	05.17.13	London AIM	No
Outsourcery plc	05.22.13	London AIM	No
Partnership Assurance Group	06.07.13	London	Yes
Bpost NV	06.20.13	Euronext B	No
Orege SA	07.04.13	Euro Paris	No
Bastei Luebbe AG	10.02.13	Frankfurt	Yes
Arrow Global Group Plc	10.08.13	London	Yes
Kromek Group PLC	10.10.13	London AIM	No
Royal Mail Plc	10.11.13	London	Yes
Tungsten Corp PLC	10.11.13	London AIM	No
Stock Spirits Group Plc	10.22.13	London	Yes
Blue Solutions SA	10.29.13	Euro Paris	No
Merlin Entertainments plc	11.08.13	London	Yes
Just Retirement Group plc	11.12.13	London	Yes
Bonmarche Holdings plc	11.15.13	London AIM	No
Infinis Energy Plc	11.15.13	London	Yes
Implanet SA	11.18.13	Euro Paris	Yes
GameAccount Network plc	11.20.13	London AIM	No
Tarkett SA	11.21.13	Euro Paris	No
Medtech SA	11.27.13	Euro Paris	No
Safestyle Uk Plc	12.06.13	London AIM	No
Carbios SA	12.12.13	AlterParis	No
Action Hotels plc	12.17.13	London AIM	Yes
RM2 International SA	12.18.13	London AIM	No
Altice Sa	01.31.14	EuronextAM	Yes
Manx Telecom Plc	02.05.14	London	Yes
Espirito Santo Saude SGPS SA	02.07.14	Euronxt L	No
Atlantis Resources Ltd	02.19.14	London AIM	No
Crossject SA	02.19.14	AlterParis	No
McColls Retail Group Plc	02.25.14	London	Yes
AO World PLC	02.26.14	London	Yes
Gaztransport & Technigaz SAS	02.26.14	Euro Paris	Yes

Poundland Group Plc	03.11.14	London	Yes
ISS A/S	03.12.14	OMX Copen	Yes
Pets At Home Group Plc	03.12.14	London	No
Boohoo.com PLC	03.14.14	London AIM	No
Gulf Marine Services PLC	03.14.14	London	Yes
McPhy Energy SA	03.18.14	AlterParis	No
XLMedia PLC	03.18.14	London AIM	No
Dalata Hotel Group Plc	03.19.14	London AIM	No
Horizon Discovery Group PLC	03.24.14	London AIM	No
Xeros Technology Group Plc	03.24.14	London AIM	No
Brit PLC	03.27.14	London	Yes
Genticel SA	04.02.14	Euro Paris	No
Just Eat PLC	04.03.14	London	Yes
Fermentalg SA	04.09.14	Euro Paris	Yes
AwoX SA	04.11.14	Euro Paris	No
Cambian Group PLC	04.11.14	London	Yes
Exova Group PLC	04.11.14	London	Yes
Polypipe Group PLC	04.11.14	London	Yes
TxCell SA	04.11.14	Euro Paris	Yes
Bagir Group Ltd	04.15.14	London AIM	Yes
Theraclion SA	04.16.14	Alternext	No
Rosslyn Data Tech PLC	04.29.14	London AIM	No
Patisserie Holdings Plc	05.14.14	London AIM	No
Card Factory PLC	05.15.14	London	Yes
Shoe Zone Plc	05.20.14	London AIM	No
Marimedia Ltd	05.22.14	London AIM	No
Stabilus SA	05.22.14	Frankfurt	No
NAHL Group Plc	05.29.14	London AIM	No
Clipper Logistics Plc	05.30.14	London	No
OneSavings Bank PLC	06.05.14	London	Yes
Game Digital Plc	06.06.14	London	No
Elior SCA	06.10.14	Euro Paris	Yes
B&M European Value Retail SA	06.12.14	London	Yes
MySale Group PLC	06.12.14	London AIM	No
Pixium Vision SA	06.16.14	Euro Paris	No
FDM Group(Holdings)PLC	06.17.14	London	No
SergeFerrari Group SA	06.18.14	Euro Paris	Yes
Volution Group PLC	06.18.14	London	Yes
Zoopla Property Group PLC	06.18.14	London	No
TSB Banking Group plc	06.20.14	London	Yes
AA PLC	06.23.14	London	Yes
River & Mercantile Asset Manag	06.23.14	London	Yes
Braas Monier Building Group SA	06.24.14	Frankfurt	Yes
Ontex Group NV	06.24.14	Euronext B	No
easyHotel Plc	06.25.14	London AIM	No
Coface SA	06.26.14	Euro Paris	No
IMCD NV	06.26.14	EuronextAM	Yes
NN Group NV	07.01.14	EuronextAM	No
Viadeo SA	07.01.14	Euro Paris	Yes
Ateme SA	07.03.14	Euro Paris	No
Intelligent Energy Hldgs PLC	07.04.14	London	Yes
Abzena Plc	07.07.14	London AIM	No
arGEN-X BV	07.08.14	Euronext B	No
Matomy Media Group Ltd	07.08.14	London	Yes
Ergomed Plc	07.09.14	London AIM	No
SSP Group PLC	07.10.14	London	Yes
Clearstar Inc	07.11.14	London AIM	No
Epwin Group Plc	07.15.14	London AIM	No

Spire Healthcare Group Plc	07.18.14	London	No
ULS Technology Plc	07.23.14	London AIM	No
Savannah Petroleum plc	07.29.14	London AIM	No
Crossrider Plc	09.24.14	London AIM	No
XXL ASA	10.03.14	Oslo	Yes
Gamma Communications Plc	10.07.14	London AIM	No
C4X Discovery Holdings PLC	10.20.14	London AIM	No
Probiodrug AG	10.23.14	EuronextAM	No
Fevertree Drinks Plc	11.04.14	London AIM	No
Constellation Healthcare Tech	12.04.14	London AIM	No
The People's Operator PLC	12.04.14	London AIM	No
Focusrite Plc	12.05.14	London AIM	No
Mercia Technologies PLC	12.12.14	London AIM	No
Market Tech Holdings Ltd	12.17.14	London AIM	No
CPP Group PLC	12.23.14	London	Yes
ScS Group Plc	01.23.15	London AIM	No
Aquatic Foods Group plc	01.28.15	London AIM	No
Bone Therapeutics SA	02.02.15	Euronext B	No
Ironridge Resources Ltd	02.04.15	London AIM	No
Eltel AB	02.05.15	OMX Stock	No
Poxel SA	02.05.15	Euro Paris	No
GrandVision NV	02.06.15	Euronext B	No
Premier Technical Svcs Grp PLC	02.10.15	London AIM	No
Tronics Microsystems SA	02.10.15	Alternext	No
Focus Home Interactive SA	02.11.15	Alternext	Yes
John Laing Group PLC	02.12.15	London	Yes
Ecoslops SA	02.17.15	Alternext	No
Wizz Air Holdings PLC	02.25.15	London	No
Eurocell PLC	03.04.15	London	Yes
Aldermore Group PLC	03.10.15	London	Yes
Revolution Bars Group Ltd	03.13.15	London	No
Zegona Communications Plc	03.13.15	London AIM	No
Lakehouse plc	03.18.15	London	No
Auto Trader Group Plc	03.19.15	London	No
Malin Corp PLC	03.20.15	Irish Stk	No
Nordic Nanovector AS	03.20.15	Oslo	No
OSE Pharma SA	03.24.15	Euro Paris	No
Redx Pharma Plc	03.26.15	London AIM	No
Refresco Gerber NV	03.26.15	EuronextAM	Yes
Sanne Group plc	03.27.15	London	No
Woodford Patient Capital	04.20.15	London	No
Biocartis Group NV	04.23.15	Euronext B	No
Ranger Direct Lending Fund plc	04.27.15	London	Yes
Amedeo Air Four Plus Ltd	04.30.15	London	No
Curtis Banks Group PLC	05.01.15	London AIM	No
Integrated Diagnostics Hldg	05.05.15	London	No
windeln.de AG	05.05.15	Frankfurt	No
Verseon Corp	05.07.15	London AIM	No
Elegant Hotels Group PLC	05.08.15	London AIM	No
TINC Comm VA	05.08.15	Euronext B	No
Stride Gaming PLC	05.18.15	London AIM	No
SPIE SA	06.09.15	Euro Paris	No
Cairn Homes PLC	06.10.15	London	No
Wallix Group SA	06.10.15	Alternext	Yes
Adgorithms Ltd	06.11.15	London AIM	No
PureTech Health plc	06.19.15	London	No
ABIVAX SA	06.22.15	Euro Paris	No
Europcar Groupe SA	06.25.15	Euro Paris	Yes

Kiadis Pharma BV	06.30.15	Euronext B	No
MySquar Ltd	06.30.15	London AIM	Yes
Orchard Funding Group PLC	07.01.15	London AIM	No
Amoeba SAS	07.07.15	Euro Paris	Yes
Kainos Group PLC	07.07.15	London	No
Cellnovo Group SA	07.09.15	Euro Paris	Yes
Menhaden Capital PLC	07.29.15	London	No
GLI Alternative Finance PLC	09.21.15	London	No
Hastings Group Holdings PLC	10.09.15	London	No
Worldpay Group PLC	10.13.15	London	Yes
Intertrust NV	10.14.15	EuronextAM	Yes
Project Fin Invests Ltd	10.20.15	London	Yes
Ibstock PLC	10.22.15	London	Yes
Equiniti Group PLC	10.27.15	London	Yes
Hostelworld Group PLC	10.28.15	London	No
Axiom European Finl Debt Ltd	11.03.15	London	No
McCarthy & Stone Plc	11.05.15	London	Yes
Georgia Healthcare Group PLC	11.09.15	London	No
The GYM Group PLC	11.09.15	London	Yes
Faron Pharmaceuticals Oy	11.12.15	London AIM	Yes
Softcat PLC(WAS 0E9974)	11.13.15	London	No
Purplebricks Group PLC	12.03.15	London AIM	No
Diurnal Group PLC	12.24.15	London AIM	No
Shield Therapeutics PLC	02.12.16	London AIM	No
Watkin Jones PLC	03.14.16	London AIM	No
Yu Group PLC	03.14.16	London AIM	No
Blue Prism Group PLC	03.15.16	London AIM	No
Maxcyte Inc	03.29.16	London AIM	No
Osirium Technologies PLC	04.11.16	London AIM	No
Witbe SA	04.12.16	AlterParis	Yes
GeNeuro SA	04.14.16	Euro Paris	No
Forterra PLC	04.20.16	London	Yes
Midwich Group PLC	05.03.16	London AIM	No
Hotel Chocolat Grp Plc	05.05.16	London AIM	No
ASIT BioTech SA	05.09.16	Euronext B	No
Oncimmune Holdings PLC	05.13.16	London AIM	No
Kerlink SA	05.18.16	AlterParis	Yes
Directa Plus PLC	05.24.16	London AIM	No
Maisons du Monde SAS	05.26.16	Euro Paris	Yes
Philips Lighting NV	05.26.16	EuronextAM	Yes
ASR Nederland NV	06.09.16	EuronextAM	Yes
Basic Fit NV	06.09.16	EuronextAM	Yes
La Francaise de l'Energie SA	06.09.16	Euro Paris	No
Time Out Group PLC	06.09.16	London AIM	Yes
Accrol Group Holdings PLC	06.10.16	London AIM	Yes
Draper Esprit PLC	06.10.16	London AIM	No
Cerinnov Group SA	06.14.16	AlterParis	Yes
Comptoir Group PLC	06.15.16	London AIM	No
GenSight Biologics SA	07.12.16	Euro Paris	No
Pharnext SA	07.12.16	AlterParis	No
SDX Energy Inc	07.25.16	London AIM	No
Autins Group PLC	08.17.16	London AIM	No
Hollywood Bowl Group PLC	09.16.16	London	No
Takeaway.com Holding BV	09.30.16	EuronextAM	No
Premier Asset Mgmt Grp PLC	10.04.16	London AIM	No
Abeo SA	10.06.16	Euro Paris	Yes
Shop Apotheke Europe NV	10.11.16	Frankfurt	Yes
Luceco PLC	10.17.16	London	Yes

Van Elle Holdings PLC	10.24.16	London AIM	Yes
Tobin Properties AB	10.28.16	FirNoStock	No
Warpaint London PLC	11.25.16	London AIM	No
DNA Oyj	11.29.16	OMXHelsink	Yes
Oxford Biodynamics PLC	12.01.16	London AIM	No
Creo Medical Group PLC	12.06.16	London AIM	No
Nextstage SCA	12.14.16	Euro Paris	No
Ramsdens Holdings PLC	02.02.17	London AIM	Yes
Lysogene SA	02.07.17	Euro Paris	Yes
Inventiva SA	02.14.17	Euro Paris	No
Xafinity PLC	02.16.17	London	Yes
Arix Bioscience PLC	02.17.17	London	No
UP Global Sourcing Hldg PLC	03.01.17	London	No
Avantium Holding BV	03.13.17	EuronextAM	Yes
Prosegur Cash SA	03.15.17	Madrid	Yes
MIPS AB	03.23.17	OMX Stock	No
Ambea AB	03.31.17	OMX Stock	Yes
Isofol Medical AB	04.03.17	FirNoStock	No
X-FAB Silicon Foundries SE	04.04.17	Euro Paris	No
Gestamp Automocion SA	04.05.17	Madrid	Yes
Actic Group AB	04.06.17	OMX Stock	No
Galenica Sante AG	04.06.17	Swiss Exch	Yes
K3 Capital Group PLC	04.06.17	London AIM	No
SSM Holding AB	04.06.17	OMX Stock	No
Eddie Stobart Logistics PLC	04.19.17	London AIM	No
Prodways Group SA	05.11.17	Euro Paris	No
Volkerwessels Nv	05.11.17	EuronextAM	Yes
Sdiptech AB	05.12.17	FirNoStock	No
Velocity Composites PLC	05.15.17	London AIM	No
Indel B SpA	05.16.17	Milan	Yes
Munters Group AB	05.19.17	OMX Stock	Yes
Alfa Finl Software Hldg PLC	05.26.17	London	Yes
Boozt AB	05.31.17	OMX Stock	No
Valbiotis SA	06.02.17	AlterParis	Yes
Balyo SA	06.07.17	Euro Paris	No
Silmaasema Oyj	06.08.17	OMXHelsink	No
GYG PLC	06.20.17	London AIM	No
FFI Holdings PLC	06.22.17	London AIM	No
Allied Irish Banks PLC	06.23.17	Irish Stk	Yes
DP Eurasia NV	06.28.17	London	No
Ethernity Networks Ltd	06.29.17	London AIM	No
Zur Rose Group AG	07.05.17	Swiss Exch	Yes
Nexus Infrastructure PLC	07.06.17	London AIM	No
Tatton Asset Management PLC	07.06.17	London AIM	No
Sherborne Invs (Guernsey) C	07.07.17	London	No
doBank SpA	07.13.17	Milan	Yes
Greencoat Renewables PLC	07.20.17	Irish Stk	No
Quiz PLC	07.20.17	London AIM	No
Arena Events Group PLC	07.24.17	London AIM	No
Strix Group PLC	07.31.17	London AIM	No
Wilmcote Holdings PLC	08.17.17	London AIM	No
Destiny Pharma PLC	09.04.17	London AIM	No
Neodecortech SpA	09.22.17	MAC AltMkt	Yes
Sparebank 1 Nordvest	09.24.17	Oslo	No
Infront ASA	09.27.17	Oslo	No
Charter Court Finl Svcs Grp	09.29.17	London	No
Pirelli & C SpA	09.29.17	Milan	Yes
Balco Group AB	10.05.17	OMX Stock	No

Alpha Finl Markets Consulting	10.06.17	London AIM	No
Handicare Group AB	10.09.17	OMX Stock	No
Biom Up SAS	10.10.17	Euro Paris	Yes
Springfield Properties PLC	10.10.17	London AIM	No
Terveystalo Oy	10.10.17	OMXHelsink	Yes
Climeon AB (publ)	10.11.17	FirNoStock	No
BioArctic AB	10.12.17	OMX Stock	No
Aedas Homes Sau	10.18.17	Madrid	Yes
Self Storage Group ASA	10.25.17	Oslo	No
Footasylum PLC	10.27.17	London AIM	No
Crayon Group Holding ASA	11.06.17	Oslo	No
Bakkavor Group PLC	11.10.17	London	Yes
Boku Inc	11.14.17	London AIM	No
Keystone Law Group PLC	11.16.17	London AIM	No
The City Pub Group PLC	11.20.17	London AIM	No
Equita Grp Spa	11.21.17	MAC AltMkt	No
TCM Group A/S	11.23.17	OMX Copen	No
Acconeer AB	11.24.17	FirNoStock	No
Alkemy Spa	12.01.17	MAC AltMkt	No
Advicenne SA	12.05.17	Euro Paris	No
Sabre Insurance Group PLC	12.06.17	London	Yes
Efecte Oyj	12.07.17	FinnFirNor	No
Mag Interactive AB	12.08.17	OMX Stock	Yes
Mirriad Advertising PLC	12.08.17	London AIM	No
Lyko Group AB	12.11.17	FirNoStock	No
Sumo Group PLC	12.18.17	London AIM	No
JTC PLC	03.09.18	London	No
The Simplybiz Group	03.16.18	London AIM	No
Vente-unique.com SASU	03.28.18	AlterParis	No
Ceva Logistics AG	05.03.18	Swiss Exch	Yes
Vivo Energy PLC	05.04.18	London	No
Rosenblatt Group PLC	05.08.18	London AIM	No
Nfon AG	05.09.18	Frankfurt	No
Avast PLC	05.10.18	London	Yes
Polyphor Ltd	05.15.18	Swiss Exch	No
Ovzon AB	05.17.18	Stockholm	No
DontNod	05.18.18	AlterParis	Yes
Team17 Group PLC	05.18.18	London AIM	No
Gore St Energy Storage Fund	05.22.18	London	Yes
Codemasters Group Holdings PLC	05.29.18	London AIM	No
Voluntis SA	05.29.18	Euro Paris	No
NCAB Group AB	06.05.18	OMX Stock	No
Carel Spa	06.07.18	Milan	Yes
Better Collective A/S	06.08.18	OMX Stock	No
Aquis Exchange PLC	06.11.18	London AIM	No
Adyen Nv	06.12.18	EuronextAM	No
Arion Banki hf	06.13.18	Nasdaq Iceland	No
Cogelec SA	06.13.18	Euro Paris	Yes
Home24 Se	06.13.18	Frankfurt	No
Tekmar Group PLC	06.15.18	London AIM	No
Capsensixx AG	06.18.18	Xetra	No
Projektengagemang Sweden AB	06.19.18	OMX Stock	No
Shelf Drilling Ltd	06.22.18	Oslo Axess	No
Mind Gym PLC	06.25.18	London AIM	No
Quilter PLC	06.25.18	London	No
Knights Group Holdings PLC	06.26.18	London AIM	No
AKASOL AG	06.27.18	Frankfurt	Yes
Calliditas(WAS 71724F)	06.28.18	OMX Stock	No

Yellow Cake PLC	06.28.18	London AIM	Yes
Amigo Holdings PLC	06.29.18	London	No
Raketech Group Holding Plc	06.29.18	FirNoStock	Yes
Esautomotion SpA	07.04.18	Milan	No
Tritax EuroBox PLC	07.04.18	London	Yes
Bio-Uv Grp Sas	07.05.18	AlterParis	Yes
Roche Bobois SA	07.06.18	Euro Paris	No
Monnalisa SpA	07.10.18	Milan	Yes
TheWorks.co.uk PLC	07.13.18	London	No
Intred Spa	07.16.18	Milan	Yes
Creditshelf Ag	07.18.18	Frankfurt	Yes
Navya SA	07.23.18	Euro Paris	No
Nucleus Financial Group PLC	07.26.18	London AIM	Yes
Argo Blockchain PLC	07.30.18	London	No
Jadestone Energy Inc	08.03.18	London AIM	No
Sensyne Health PLC	08.14.18	London AIM	No
Sig Combibloc Group AG	09.28.18	Swiss Exch	Yes
MedinCell SA	10.03.18	Euro Paris	Yes
Westwing Group AG	10.08.18	Frankfurt	No
Knorr-Bremse AG	10.10.18	Frankfurt	No
Shurgard Self Storage Europe	10.12.18	Euronext B	No
Neoen SAS	10.16.18	Euro Paris	Yes
Garofalo Health Care SpA	11.06.18	Milan	Yes
Gresham House Energy Storage	11.09.18	London	No
Oma Saastopankki Oy	11.29.18	OMXHelsink	No
Kropz PLC	11.30.18	London AIM	No
Manolete Partners PLC	11.30.18	London AIM	No
Jetpak Top Holding AB	12.04.18	FirNoStock	No
Lime Tech Ab	12.06.18	OMX Stock	No
Q-Linea AB	12.06.18	Stockholm	No
Zwipe AS	01.21.19	Oslo	No
Marinomed Biotech AG	01.29.19	Vienna	No
Sequana Medical NV	02.08.19	Euronext B	No