The Influence of Overallotment Options and Price Stabilisation in the IPO Aftermarket

A Quantitative Study of 73 Swedish Initial Public Offerings

OSKAR WILHELMSSON[a] & BJÖRN NILSEN[b]

M.Sc. Thesis in Finance
Department of Finance
Stockholm School of Economics
December 2019

ABSTRACT

Underwriters are normally granted an overallotment option by issuers in conjunction with initial public offerings (IPOs). Prior research has established that its main purpose is to enable underwriters to engage in price stabilisation activities in the aftermarket of an IPO. Moreover, past studies agree that the overallotment option incurs a substantial incremental cost to the issuer, while there is no consensus as to whether price stabilisation has an impact on new listings. In this study, we assess the impact of price stabilisation on the width of the bid-ask spread in the immediate aftermarket for 73 Swedish initial public offerings between 2010 and 2019. We find that stabilised companies experience on average an 11 percent decrease in the width of the bid-ask spread, but that this effect is limited only to the first days of trading. While this implies that stabilisation can affect a new equity offering, we leave it to future research to further explore whether the overallotment option is worth the costs it entails for the issuer.

Keywords: Overallotment Option, Price Stabilisation, Initial Public Offerings, Aftermarket Trading, Bid-Ask Spreads

---

We would like to thank our thesis supervisor, the Executive Director of the Swedish House of Finance, Anders Anderson, for his guidance and valuable input during the writing of this thesis. Any errors are our own.

[a]23441@student.hhs.se [b]23481@student.hhs.se

Table of contents

1. Introduction ... 1
1.1 Background ... 1
1.2 An overview of the IPO process in Sweden ... 3
2. Theoretical framework ... 6
2.1 The overallotment option ... 6
2.2 The value (cost) of the overallotment option ... 7
2.3 Overallotment options in the context of underwriter aftermarket activities ... 9
2.4 The effect of price stabilisation ... 10
3. Research hypotheses ... 12
4. Data ... 14
4.1 Data collection and handling ... 14
4.2 Description of the bid-ask spread ... 15
4.3 Characteristics of the overallotment option ... 17
5. Methodology ... 20
5.1 The effect of price stabilisation on the bid-ask spread ... 20
5.2 Cross-sectional regressions ... 20
5.3 The stabilisation proxy ... 21
5.4 The stabilisation dummy ... 22
5.5 Regression variables ... 24
5.6 Evaluating the feasibility of the models ... 26
6. Results and discussion ... 27
6.1 Regression results for the stabilisation proxy ... 27
6.1.1 Full sample regression ... 29
6.1.2 Above floor price (AFP) regression ... 30
6.1.3 Below floor price (BFP) regression ... 31
6.2 Regression results for the stabilisation dummy ... 33
7. The implications of our results ... 35
8. Conclusion ... 37
9. Limitations and future research ... 38
9.1 Limitations ... 38
9.2 Suggestions for future research ... 39
10. References ... 41
11. Appendix ... 43

1. Introduction

1.1 Background

"Most people don't know what a greenshoe is. Most people that know what a greenshoe is don't understand the greenshoe. It couldn't be more esoteric [...] in every IPO they sell 15 per cent more shares than what you have talked about the entire time you're planning the IPO. It's called the overallotment option [...] if it pops and goes up [...] you just did a 15 per cent bigger raise than you were planning on."

Bill Gurley[1] (O'Shaughnessy, 2019)

IPOs are one of the most thoroughly scrutinised topics of research in finance. Numerous researchers have dedicated time and effort to better understand what factors affect the performance of IPOs, especially the relationship between the underwriting banks and the issuers has been of great interest in previous research. When it comes to the aftermarket behaviour of the underwriters in the IPO setting, focus has been directed to their market making and price stabilisation activities. One of the integral features in the arrangements between the issuer and the underwriter is the *overallotment option* (OAO or greenshoe option), which allows the banks to engage in price stabilisation of the offering while limiting its own capital at risk. Research on the overallotment option has concluded that the overallotment option incurs a substantial cost to the issuer, while it remains ambiguous as to whether it fills its purpose to effectively stabilise poorly performing issues. Its existence has been questioned in recent years by high-profile investors and company leaders of some of the largest privately held companies. It is one of the reasons why some of them have vied for direct listings instead of traditional IPOs, thereby circumventing the overallotment option (O'Shaughnessy, 2019).

In order to assess the impact of the overallotment option and price stabilisation of newly issued equities, we analyse 73 IPOs in Sweden between 2010 and 2019 with data from the Nasdaq Stockholm main markets. The study aims to investigate the impact of price stabilisation on the bid-ask spread for newly listed companies. We use two different approaches to test this, using pooled cross-sectional regressions, described in section 3.1. Firstly, we mimic previous research on the topic and regress the bid-ask spread on a price stabilisation likelihood proxy, to examine the impact of stabilisation in the initial aftermarket trading. Secondly, we present a

[1] General Partner at Benchmark Capital

different approach compared to previous research by collecting data from company press releases regarding dates of stabilisation. Following this, we examine the impact of price stabilisation by regressing the bid-ask spread on an empirically derived stabilisation dummy on whether a company is stabilised or not. Model specifications and the rationale behind the stabilisation variables are described in more detail in section 5.

Our contribution to the existing body of research on the overallotment option and price stabilisation is threefold. Firstly, we are the first to our knowledge to examine the value of the overallotment option and the impact of price stabilisation on the Swedish market. Secondly, we present findings indicating that the commonly used stabilisation proxy suffers from potential shortcomings, which are dependent on the sample data in use. Thirdly, we introduce a stabilisation dummy, derived from empirical observations on dates of stabilisation. This variable allows us to pinpoint exactly when underwriters are stabilising new listings, allowing us to better isolate the impact of stabilisation on the bid-ask spread in comparison to previously used methodologies.

We find that shares trading closely to their respective listing prices on average have narrower bid-ask spreads, which we argue is explained by price stabilising activities from the underwriter(s). This effect is however evident only in the initial days of trading as it fades out past the first week of trading. Additionally, we find that stabilised shares have narrower spreads, but also that this effect is limited to the initial days of trading, even though these shares are being stabilised for approximately 20 days on average. Furthermore, we note that the stabilisation proxy is less informative when used on samples that include poorly performing stocks.

The remainder of this paper is structured as follows. Section 1 gives an overview of the IPO process in Sweden. Section 2 presents our theoretical framework in the field of the overallotment option, leading up to our research hypotheses, which are detailed in section 3. Section 4 in turn describes our data processing and showcases traits of our dataset. Section 5 outlines our methodology. In section 6 we present our regression results that are then put into context in relation to previous research and further discussed in our section 7. Section 8 concludes the findings of our paper. The final section 9 gives the reader a sense of the limitations of this study, as well as our suggestions on interesting research topics going forward.

1.2 An overview of the IPO process in Sweden

In Table 1 that is presented below we briefly explain the stages and processes of a company going public (*the issuer*) on one the Swedish main markets. The IPO process is initiated by the issuer selecting a *lead underwriter* (“underwriter” is used interchangeably with “investment bank” and “bank”), and in some cases appointing *co-managers* to co-lead the “book-running” efforts prior to the listing of the stock. The agreement is formalised when the issuer and the underwriter(s) sign a letter of intent (LOI), in which details regarding the IPO engagement are agreed upon, stipulating among other things the inclusion of an overallotment option, gross proceeds to the bank, and more.

Following the LOI signing, the project phase is initiated which details the exact date for the IPO. This is also when the detailed due-diligence process is instigated, which findings are then consequently used to pitch *institutional investors*. In parallel with the project phase, the *exchange* (e.g. Nasdaq) makes its own assessment of the company intended to go public, in which it appoints external auditors to provide material to the exchange for a final decision. Their findings are then presented to a designated committee of decision makers that decides on whether the company will be admitted to the exchange.

In order to provide information to potential investors to form a substantiated opinion about the offering, the issuer is mandated to publish its IPO prospectus prior to its listing. This document is prepared by the underwriter and is pre-read and pre-approved by *Finansinspektionen* (the Swedish Financial Supervisory Authority) prior to its publishing date. Once the prospectus has been approved, the underwriter alongside the issuer can start pitching their material to institutional investors in a process that is known as the roadshow, which is also the start of the subscription period. Throughout the roadshow, the underwriter collects indicative subscription interests at various price levels for certain amounts of shares from institutional investors, for the purpose of setting the final price of the offering. The indications of interest to subscribe are however not legally binding, why institutions can pull back from the offers and renege on their previously shown interest in being allocated shares in the offering. *Retail investors* are not pitched to in the roadshow but can pose binding offers in attempts to subscribe to the offering, awaiting the final allocation of the shares being sold.

Once the subscription period is over, it is up to the bank to allocate the issuance to the interested investors. In allocating, the underwriter must take into consideration what investors are best equipped to provide liquidity to the stock as well as requests from the issuer on owners likely to hold the stock as long-term shareholders. Any unallocated part of the offering will be kept by the bank. The final allocation is close in time to the initial trading of the stock, which is when the overallotment option and price stabilisation comes into relevance. In Table 1 below, we will describe the IPO process, overallotment option and price stabilisation in more detail.

Table 1: The IPO process in Sweden

1 – Selection of lead underwriter and co-managers	Issuers pick the investment bank of their choice to lead the IPO. The role of the lead underwriter includes setting up the syndicate and managing the IPO process from start to finish. At this stage, any potential conflict of interest and similar must be addressed, as prescribed by Swedish regulation.
LOI	The LOI is the initial agreement that is entered between the bank and the issuer. Intended to protect the bank against unexpected costs e.g. in the event of a cancelling of the offering. The LOI specifies the gross spread, normally between 2-7 percent of the total offering (Ritter, 2019) and establishes the commitment to grant an overallotment option of up to 15 percent to the underwriter.
2 – Project phase	Once the underwriter has been assigned and accepted the terms for the IPO that have been defined between the issuer and the underwriter, the preparation for the transaction of selling shares to public investors is initiated. This includes practicalities such as the timing and the structure of the issue, but also establishing the price point at which the issuer is going public. It is worth noting that the final price is always determined by the issuer, but that the bank lays the groundwork in proposing a price range established from engagements with the investor community, as detailed below.
3 – Registration of intention to go public	When a company wants to go public, it is mandated that they prepare for a listing on a regulated marketplace, such as the Nasdaq OMX. This process normally starts between 6-12 months prior to the IPO date. The process consists of the exchange appointing a third-party auditor to assess the feasibility of the issuing company being a listed entity. The final decision on whether to allow for the listing to happen or not is taken by a designated committee on the exchange, and is based on the auditor's report and recommendation.
4 – IPO Prospectus	A company offering shares to the public in an IPO is mandated to present an IPO prospectus, which is an informational document in writing that is pre-read and approved by *Finansinspektionen*. A pre-read and approved prospectus must include enough information for third-party investors to be able to form a duly substantiated opinion of the company. The prospectus needs to provide investors with detailed financial information, information on the business in general and specificities of the company that can affect the stock price performance. The preparation of the document is led by the underwriter. The regulations regarding what has to be included in an IPO prospectus are provided by the European Commission (EC) and are valid in all of Europe without further approval for marketing the stock in new markets within the perimeters of the EC. Making the prospectus public is a prerequisite for an IPO, the latest on the day before the stock is going public.

5 – Marketing (Roadshow/ book building & subscription period)	Once the prospectus has been approved by *Finansinspektionen*, the underwriter together with the issuing company initiates meetings with investors that are considered important in the IPO transaction, a process called the "roadshow". The role of the underwriter at this stage is to coordinate meetings for the issuing company to pitch to relevant investors. In relation to this, the subscription period for the new stock is opened. At this stage, the investors assess the prospectus and indicate their interest to acquire stock based on the established price or price range in the prospectus, this process is known as the book building process. The indicative willingness to acquire shares upon the listing are non-binding commitments and are subject to change or cancellation throughout the entirety of the subscription period. The book building data is used to decide on the final price of the listing and is kept and collected by the underwriter's equity capital markets division. For retail investors wanting to subscribe to the issuance, their offers are legally binding up to the highest price in the interval of the prospectus.
6 – Share allocation and initial trading	Once the subscription period has ended, it is up to the underwriter to allocate the shares based on the offers made in the book-building process. The underwriter needs to assess what investors should receive an allocation, considering e.g. which investors will provide enough liquidity in the stock once publicly traded. The allocation of shares must also consider requests from the issuer to provide enough shares to perceived long-term owners. If the underwriter fails to allocate all shares, it will itself keep the inventory position that goes unsold to public investors. Once the bank has completed a proposal of how to allocate the shares, the final decision is made by the issuing company. Subsequently, the announcement is made to the investors receiving an allocation. In relation to the announcement of the allocation to the investors, the issuer also goes public with the outcome of the IPO (e.g. the rate of oversubscription), and the stock starts trading.
7 – The overallotment agreement and the overallotment option	In the majority of IPOs, it is common practice that there is an overallotment agreement. The practical function of the overallotment agreement is to give the underwriter the possibility to issue additional (ovarallot) shares (up to 15 percent of the total issuance), if the demand for the listing is strong from investors once the stock starts trading. Within the framework of the overallotment agreement, the underwriter is granted an overallotment option, which gives the underwriter an option to acquire the overalloted shares from the issuer within the first 30 days of trading. The additional issuance is borrowed from the owners of the issuing company before the option is exercised, which in practice implies that the underwriter holds a net short position in the issued stock. The underwriter may then close this position by exercising the OAO within 30 trading days from the listing date or by covering the position in open market share purchases.
8 – Price stabilisation	In IPOs, the issuing company, the underwriter and investors all have an interest in the share price not dropping below the listing price in the initial period of trading. In the event that the stock price declines below the listing price, underwriters normally engage in price stabilisation to maintain the share price at levels that would not otherwise have prevailed. This activity is strongly related to the overallotment option, since the underwriter can make supporting purchases in the initial aftermarket without assuming inventory risk, provided that the number of purchased shares does not exceed the numbers of shares included in the short position that the underwriter entered because of the overallotment option. Given that the activity can lead to artificially high share prices, the practice is heavily regulated by *Finansinspektionen* and is only permissible if the stock is trading below or at its listing price. Additionally, *Finansinspektionen* limits the degree of price stabilisation to the number of shares that are covered by the OAO. The underwriter must cease its stabilising activities at the latest upon the maturity of the option, after 30 trading days.

2. Theoretical framework

2.1 The overallotment option

In the book building process leading up to the final listing price of an IPO, investors indicate an interest in the offering and express their willingness in acquiring shares in the issuing company. For the bank pricing the IPO, there is a reputational aspect at play vis-á-vis the investor landscape (including clients) and the issuing company, which mostly comes down to pricing the issue accurately while satisfying the needs of the main stakeholders. Therefore, the bank is faced with a trade-off of pricing the IPO mainly catering to its own and its institutional clients' interests, or the interest of the issuing company. In underpricing, the bank wants to ensure that the offering is fully subscribed and has an attractive enough return profile for its institutional investors that are buying the IPO, while simultaneously not disfavouring the issuing company by leaving too much money on the table. In the event of the underwriter failing to allocate all shares in a listing, they will themselves keep the inventory and thus remain with a net long position in the stock. To mitigate this risk, the lead underwriter typically overallots up to 15 percent of the total offering within the framework of the overallotment agreement, as evidenced by Muscarella et al. (1992), Aggarwal (2000) and Franzke & Schlag (2003). Consequently, as the overalloted shares are borrowed from the issuer, the underwriter enters a short position of equivalent size (Finansinspektionen, 2007). As an effect of the short position, there is a lower risk for the underwriter to end up with a long inventory position. This is because any shares that are not distributed can be used to cover the short position.

When entering the short position, an obligation to the owners of the stock is established, where the underwriter has two options to close the position. The first is to cover the short position by purchasing the corresponding number of shares on the open market. The other alternative is to exercise the *overallotment option*, where the underwriter is entitled to acquire the equivalent number of shares of the short inventory position from the issuer. Should the overallotment option be exercised, the underwriter pays the listing price minus an underwriting spread of normally between 2-7 percent for the shares (Ritter, 2019). Whether the bank closes its short position by purchasing shares in the open market or decides on exercising the overallotment option depends on the share price development. Should the price decline from the listing price, it is rational and more profitable for the bank to engage in open market short covering, whilst a price increase makes it rational and more profitable to repurchase the shares at the listing price by exercising the overallotment option.

The exercise of the overallotment option is managed by the underwriter and any potential profits are kept by the bank as evidenced by Aggarwal (2000). Empirical evidence that underwriters short cover if the share price drops below the listing price, whereas underwriters exercise the overallotment option in the event of a price increase is documented by Franzke & Schlag (2003), Muscarella et al. (1992), Ellis et al. (2000) and Schultz & Zaman (1994).

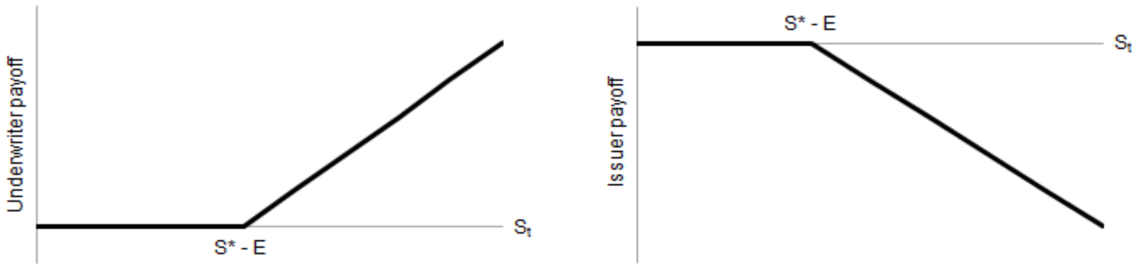
2.2 The value (cost) of the overallotment option

While the issuer is not compensated in monetary terms for granting the overallotment option, it holds a positive value to the underwriter. In practice, the underwriter holds a loss-hedged portfolio as argued by Franzke & Schlag (2003), comprised of a short position in the stock and an overallotment option. The overallotment option bears striking similarities to an American call option with a strike price equal to the listing price minus the spread, which has led researchers to value it using option-pricing frameworks.

The hypothetical payoff structures for the underwriter and the issuing company for the option in isolation, as well as the payoff structure for the net position held by the bank (OAO combined with a short position), are outlined in Charts 1 and 2, below. Hansen et al. (1993) and Franzke & Schlag highlight the resemblance of the overallotment option payoff to that of a long American call option. Conversely, to the issuer, the payoff resembles a short call (see Chart 1). Thus, both studies suggest an appropriate valuation of the call option ex-ante, can be derived using the Black-Scholes (1973) option pricing formula. Another measure of determining the value of the overallotment option is proposed by Bajo et al. (2017), which is based on the payoff diagram to the underwriter (see Chart 2). The authors argue that the option gives the underwriters a payoff scenario akin to that of an American put option.

The studies by Bajo et al. and Hansen et al. both reach the conclusion that the total value of the overallotment option adds an additional flotation cost to the issuer equivalent to approximately 1 to 1.5 percentage points, adding to the underwriter fee of 2 to 7 percent of the gross proceeds. In another study of a listing on the Hong Kong Stock Exchange, Quboa et al. (2017) find that stabilisation activity generated more profits than the total underwriting commission, for the underwriter. Given these findings, the cost of the overallotment option should not be overlooked when studying the IPO process.

Chart 1: Payoff diagram for the underwriter (long call) and issuer (short call) from the overallotment option



Note: The payoff diagrams above showcase the theoretical payoffs for the underwriter and the issuer that are a consequence of the overallotment option. S* is the offering price of stock *i*. S_t is the aftermarket share price at time *t* and E is the underwriter gross spread.

Chart 2: Payoff diagram for the underwriter (long put)

Note: The payoff diagrams above showcase the theoretical payoffs for the underwriter that are a consequence of the overallotment option and the short position in combination. S* is the offering price of stock *i*. S_t is the aftermarket share price at time *t* and E is the underwriter gross spread.

In valuing the OAO with the Black-Scholes option-pricing formula there are some drawbacks that need to be highlighted. Firstly, Muscarella et al. (1992) note that the OAOs are most commonly exercised prior to their expiration date. However, this differs from conventional option theory that suggests that the optimal exercise date is upon maturity for non-dividend paying stocks (Merton, 1973). Secondly, the price of the underlying stock upon maturity is expected to be exogenously determined. In the case of the overallotment option, the underwriter (who is also the holder of the option) will likely have an influence on the price of the underlying stock, bearing in mind that the underwriter plays an instrumental role in pricing the IPO. Despite these drawbacks, academia to date has found the Black-Scholes option pricing formula to be adequate in pricing the overallotment option.

2.3 Overallotment options in the context of underwriter aftermarket activities

By granting an overallotment option, the issuer and the regulatory bodies assume that the underwriting bank will engage in aftermarket activities. Research by Molchanow (2007), Boehmer & Fishe (2004) and Ellis et al. (2000) shows that underwriters do take on responsibilities in the aftermarket following the issue, mainly by acting as market makers. In a study of the US Nasdaq market, Ellis et al. establish that the lead underwriter assumes the role as market maker in every IPO and remain so for a long time after the public market listing. Moreover, the study also finds that co-managers assume roles as market makers, though for a shorter period of time compared to the lead underwriter. Two primary reasons are given by the authors for why the banks do so. Firstly, to provide liquidity to the stock. Secondly, to support the stock price by engaging in price stabilisation. In practice, price stabilisation is the act of the underwriter buying shares in the open market to support the share price of a stock. According to Finansinspektionen (2007) price stabilisation is the main purpose of the overallotment option, and that it may lead to price levels that would normally not have been supported by the market without underwriter intervention. Importantly, Swedish regulation states that price stabilisation may not be carried out if the stock trades above its listing price or if the number of purchased shares for stabilisation purposes is in excess of the 15 percent granted by the overallotment option.

Ellis et al. find evidence that underwriters never accumulate more inventory than is covered by the overallotment option in its market making and stabilisation efforts, hence making those activities risk-free from an inventory perspective, with the condition that the overallotment option has neither expired nor been exercised. This is further validated by Hanley et al. (1993) and Bajo et al. (2017), who highlight that price stabilisation only occurs for new issues that are trading below the listing price. Since stabilisation takes place at or below the listing price, while the underwriter entered its short position at listing price, stabilisation is normally profitable for the underwriter.

2.4 The effect of price stabilisation

Whether price stabilisation has any impact on new issues or not, is a subject that has received limited attention in previous research. The studies that have been conducted have led to ambiguity in the understanding of its effects. One of the most commonly used methods to understand the impact of stabilisation in the aftermarket trading for a new issue has been to consider the effect of stabilisation on the bid-ask spread.

Schultz & Zaman (1994) argue that underwriters quote higher bid-prices than other market makers that commence trading at or below the offer price in order to stabilise the new listing, which has a narrowing effect on the bid-ask spread. Also, Bajo et al (2017), Chung et al. (2000) and Hanley et al. (1993) argue that the bid-ask spread should narrow when a share price is stabilised as the underwriter quotes higher bid-prices than other market makers, while ask-prices remain unaffected. They also argue that the effect of stabilisation should be evident for shares that are trading below their listing prices, as this is where stabilisation is most likely to occur. Additionally, Hanley et al. suggest that stabilisation has a narrowing effect on the bid-ask spread also for shares trading slightly above the listing price. Although price stabilisation is legally not permitted at prices above the listing price, this effect can be explained by the notion that investors take into account that a price decline leading to a price level below the listing price, likely will be countered by underwriter stabilisation activities. Hence, investors can quote higher bid-prices and the bid-ask spread should narrow.

To test whether price stabilisation has any considerable impact on new issues, Hanley et al. examine the relationship between the bid-ask spread and a proxy for underwriter stabilisation for a set of US IPOs. The proxy is defined as the distance from the listing price that a share is trading at and is meant to measure the likelihood of an underwriter engaging in price stabilisation activities. The rationale for the proxy is that shares that are trading closely to, or below, their respective listing price are likely to be stabilised, whereas shares that are trading far above their respective listing price are not stabilised. Hanley et al. find evidence that the bid-ask spread narrows when a share is trading below or close to its listing price, with the effect gradually decreasing for each trading day that passes from the IPO date. This effect lasts for up to 10 days of trading. Conclusively, they argue that this provides support for price stabilisation having an impact in the initial aftermarket for new issues.

Bajo et al. (2017) and Chung et al. (2000) also study the effects of price stabilisation using similar methodologies. They both present contrasting results to those of Hanley et al. and find limited or no evidence supporting that price stabilisation has any evident impact on new issues. Instead, they argue that the overallotment option is to the benefit of the underwriter only and that its inclusion leaves the issuer worse off, if measured from a price stabilisation perspective. Additionally, Franzke & Schlag (2003) consider the impact of stabilisation on the level of underpricing, and also fail to conclude that stabilisation has a pronounced effect. Whether price stabilisation has any evident impact on new issues or not is therefore something that remains ambiguous. In order to better understand the rationale of the overallotment option we believe it is important to further study the implications of price stabilisation in the context of IPOs.

3. Research hypotheses

The overallotment option can provide substantial value to the underwriter as shown by Franzke & Schlag (2003), Bajo et al. (2017), Muscarella et al. (1993) and Hansen et al. (1993). In return for granting the overallotment option, the issuer expects the underwriter to play an active role in the initial aftermarket and engage in price stabilisation if needed. Evidence for underwriters participating in such activities is well documented by Molchanow (2007), Schultz & Zaman (1994), Hanley et al (1993) and Boehmer & Fishe (2004). Furthermore, findings by Ellis et al. (2000), Franzke & Schlag, Aggarwal (2000) and Muscarella et al., argue that the overallotment option not only eliminates the inventory risk that arises from price stabilisation, but also makes it profitable to the underwriter. However, research remains ambiguous in providing an answer to whether price stabilisation has an impact on a newly issued share, and there is no consensus regarding if price stabilisation is worth the cost that arises to the issuer from granting the overallotment option.

Prior research in the field has primarily focused on examining the impact of price stabilisation by studying its effect on the bid-ask spread. The rationale for studying the bid-ask spread, is that stabilised companies should have narrower spreads, given that stabilisation activity leads to the underwriter quoting higher bid-prices than other agents in the market. Although the impact from price stabilisation arguably affects more than just the bid-ask spread, the bid-ask spread is a suitable way to better understand whether price stabilisation influences a newly listed stock at all. By studying the bid-ask spread, Hanley et al. and Schultz & Zaman argue that the impact of stabilisation is evident in the initial aftermarket whereas Chung et al. (2000) find no evidence in support of that notion. Given these circumstances we find it necessary to explore this area further, including some methodological adjustments in comparison to prior studies.

We follow the previously discussed reasoning of Hanley et al., Chung et al. and Bajo et al., where we argue that price stabilisation should have a narrowing effect on the bid-ask spread. Additionally, we also make use of the stabilisation likelihood proxy proposed by Hanley et al., in order to approximate which companies are stabilised and which are not. With this methodology, we test if price stabilisation exhibits an impact on the bid-ask spread in the initial aftermarket of new issues. We do this by testing if shares that are trading slightly above or below the listing price have narrower spreads than shares trading far above the listing price, as these are the ones that can be influenced by price stabilisation activity. Thus, our first hypothesis is formulated as follows:

Hypothesis I: The bid-ask spread will be narrower for shares trading below or slightly above their listing prices compared to shares trading far above the listing price.

The price stabilisation proxy used in previous research assumes by construction a linear relationship between stock price performance and the bid-ask spread, in which worse-performing stocks will experience more price stabilisation. While this might be true, there are some drawbacks with this assumption. For example, shares trading far below their listing price are unlikely to be successfully stabilised due to a too high selling pressure (Hanley et al., 1993). With this rationale, the effect of price stabilisation should be less pronounced for shares trading far below their listing price compared to shares trading more closely to it. Therefore, in comparison to prior research we amend the implicit assumption that shares trading below their listing price should experience more stabilisation. To adjust for this amendment, we test if shares that are trading closely (slightly below or slightly above) to the listing price have narrower spreads than shares trading far above the listing price. Thus, we amend the sample to only include shares trading above or slightly below their listing price. This leads us to our second hypothesis:

Hypothesis II: The bid-ask spread will be narrower for shares trading slightly above or slightly below their listing prices compared to shares trading far above their listing prices.

Due to the ambiguity in previous research with regards to the impact of price stabilisation, we extend our analytical framework by creating an empirically derived dummy variable which states if a company is stabilised or not. We then conduct a similar analysis as when using the stabilisation proxy, but instead of testing if the bid-ask spread is narrower for shares trading closely to their listing price, we test if the bid-ask spread is narrower for shares that are stabilised compared to shares that are not stabilised. This implies that the analysis of the effects on the bid-ask spread does not stem from an assumption on whether stabilisation is likely or not, but on empirical data of actual stabilisation. Moreover, this mitigates the risk of our model specification suffering from omitted variable bias, further discussed in the methodology section. This analysis allows us to understand the impact of price stabilisation from another viewpoint, shedding additional light on conclusions drawn from prior research and for the other tests in our study. Therefore, we formulate our third hypothesis:

Hypothesis III: The bid-ask spread will be narrower for shares where the underwriter engages in price stabilisation.

4. Data

4.1 Data collection and handling

Our initial dataset consists of all IPOs on Nasdaq's main markets in Sweden in the period between January 2010 and July 2019. In order to identify all listings on Nasdaq, we obtain company names and listing dates of all public offerings on the Swedish small-, mid- and large cap markets on the Nasdaq website, yielding an initial sample consisting of 135 listings. To make the sample more relevant to our analysis, we exclude all events that did not include an equity offering to the public, including secondary offerings, demergers and list transfers, reducing the sample with 58 companies. For each of the remaining 77 companies, we collect additional information from Finansinspektionen and the individual listings' IPO prospectuses to extract information of IPO dates, listing prices, lead underwriters, co-leads, company symbols (tickers), number of shares issued, inclusion of an overallotment option and the size of the overallotment option. Furthermore, we exclude an additional 4 observations in which cases we were not able to find evidence of the inclusion of an overallotment option, leaving us with a final sample of 73 IPOs.

Table 2: Data processing overview

Sample description	**Removed observations**	**Remaining observations**
Total number of listings	0	135
List transfers	35	100
Demergers	9	91
Dual listings	6	85
Secondary	4	81
Other	4	77
No overallotment option	4	73
Final Sample	**62**	**73**

Note: The initial data sample is collected from Nasdaq OMX's main market listing overview on their webpage. The remainder of the data and the processing of it has been done manually by collecting the information from the above-mentioned sources of information. The table above shows our processing of the dataset and detailed reasons for exclusion of observations, to limit the sample to companies of relevance for the purposes of our study.

To obtain additional necessary information, we collect data from the Nasdaq HFT database retrieved from the website of Swedish House of Finance, containing order book data on intraday trading for the companies in our sample. For all transactions taking place, each individual dataset contains the transaction prices and volumes, bid prices, ask prices and the exact timing of each individual trade taking place. The order book data is then merged with our manually collected database, to add information for each company in the sample on the overallotment size, overallotment exercise dates, dates of stabilisation, number of underwriters and the listing price. With this information at hand, we have the data required to run our regressions.

4.2 Description of the bid-ask spread

In our sample, we notice that the spread metrics for the initial five days are consistently lower compared to later periods (Table 3). In addition, the data reveals that the average and the median value of the bid-ask spread increases from period to period across all sub-samples bar the last one, in which it declines slightly compared to days 21-25. In appendix A3, we present histograms of the bid-ask spreads for all time periods. The data suggests that the distribution of bid-ask spreads is becoming increasingly positively skewed, as we note that the right-tail of the distribution creeps upwards over time after the first five days off trading.

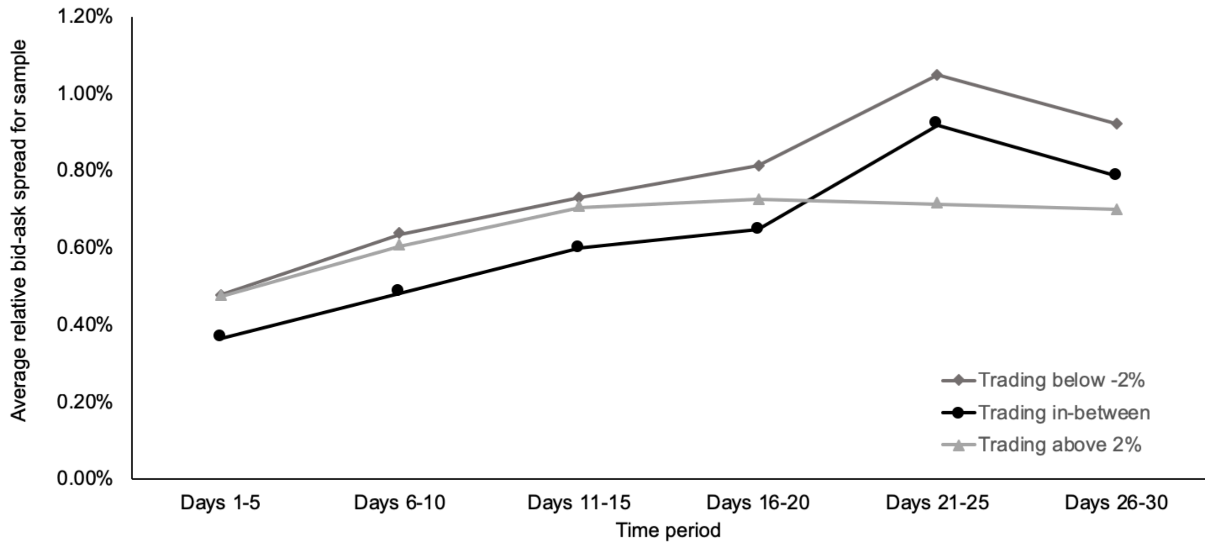
Table 3: Summary statistics of bid-ask spreads

	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Days 1–5	0.06%	0.32%	0.42%	0.46%	0.55%	1.55%
Days 6–10	0.11%	0.41%	0.53%	0.63%	0.69%	5.46%
Days 11–15	0.14%	0.45%	0.57%	0.72%	0.82%	3.88%
Days 16–20	0.12%	0.45%	0.61%	0.77%	0.89%	5.09%
Days 21–25	0.13%	0.47%	0.67%	0.87%	1.00%	4.49%
Days 26–30	0.18%	0.48%	0.64%	0.80%	0.91%	6.34%

Note: The table summarises spread metrics for our sample of IPOs for the first 30 days of trading. The metrics are summarised for each block of five trading days in the initial aftermarket. Details on calculations of bid-ask spreads are discussed in Section 5.

Moreover, in appendix A4 the spreads and price development for each observation for the same time periods are plotted for each company. By plotting the bid-ask spread against the share price development for each share, it seems like the bid-ask spread is slightly wider for stocks trading further away from their listing price, at least for the initial time periods (see Chart A2 in the Appendix). This pattern is also presented graphically in Chart 3, below. The chart highlights changes over time in bid-ask spreads for different sub-samples of the data, depending on the distance between their share price and the price they were listed at. Notably, the sample "*Trading in-between*" on average has narrower bid-ask spreads during the first 20 days of trading compared to the other samples, and this sample includes the shares that we believe are more affected by stabilisation than others as they are trading closely to the listing price. Additionally, there is an increase in the bid-ask spread for the samples *"Trading below -2%"* and *"Trading in-between"* after day 20. Interestingly, this increase applies to the two samples where stabilisation is possible and the increase occurs when stabilisation activity begins to cease, which we will discuss in more detail in section 4.3 below. Although the visual analysis is not robust, the findings are in line with our hypotheses.

Chart 3: Development of bid-ask spreads for different sub-samples



Note: The chart presents the average bid-ask spread for companies in our sample depending on their share price development in relation to their listing price. For every five-day block, each sample is recalculated.

4.3 Characteristics of the overallotment option

For our sample containing 73 IPOs, almost all included an overallotment option with a size equivalent to 15 percent of the offering (see Table A1 in appendix for company specific OAO sizes). Notably, this finding implies that there is limited negotiation regarding the size of the option, since that would have provided more variety in the data.

Moreover, for each company in our sample we retrieve information on whether or not the overallotment option was exercised. In doing this, we find that all options were fully exercised for the 38 issues trading strictly above the listing price in the initial 30 days of trading. For those issues trading both above and below the listing price in the initial 30 trading days, the overallotment option was fully exercised in three cases, partially exercised in 17 cases, and not exercised at all in seven cases. Lastly, for the eight issues that traded strictly below the listing price, seven overallotment options were not exercised at all.

Table 4: Underwriter's exercise of the overallotment option

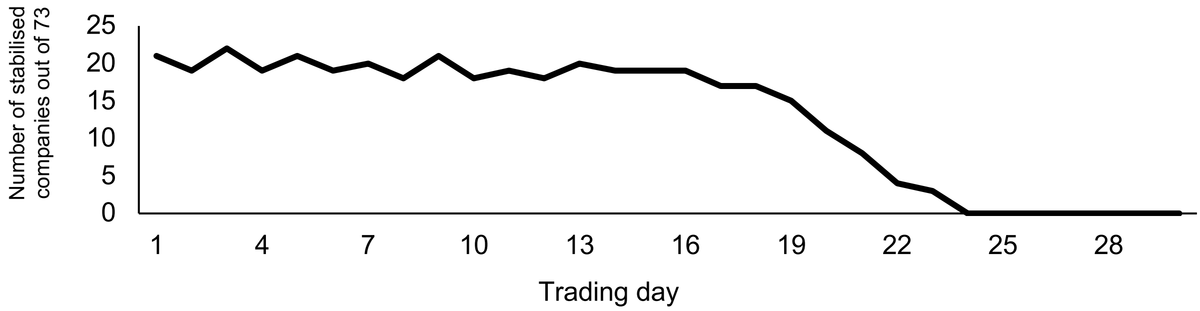
Sample	OAO not exercised	OAO partially exercised	OAO fully exercised	Total
Issues trading strictly above the listing price	0	0	38	**38**
Issues trading both above and below the listing price	7	17	3	**27**
Issues trading strictly below the listing price	7	0	1	**8**
Total	**14**	**17**	**42**	**73**

Note: Information regarding the exercise of the overallotment option is collected from press releases from individual company websites upon exercise or finalisation of stabilisation.

The data suggests that the overallotment option is exercised only when profitable to do so. However, for one IPO, the underwriter seems to have deviated from this strategy as the overallotment option was fully exercised even though the share traded strictly below its listing price. While this is counterintuitive, there is a scenario in which this makes sense. If a stock is consistently trading slightly below the listing price, albeit above the listing price minus the underwriter spread, it is more profitable to exercise the overallotment than to short cover (see charts 1 and 2).

Furthermore, we also collect data from company press releases on whether the underwriter engaged in price stabilisation activities or not, along with the dates of stabilisation for companies that were stabilised. For the 42 issues where the overallotment option was fully exercised, no stabilisation occurred. For the remaining 31 issues where the overallotment option was either fully or partially exercised, we find that all underwriters engaged in price stabilisation. However, we were only able to collect dates of stabilisation for 28 companies, as three of the them did not disclose this information in publicly available documentation as of the time of this study. A summary of the information is presented in Chart 4, below.

Chart 4: Graphical overview of the number of stabilised companies in the initial thirty trading days



Note: Information regarding dates of stabilisation is collected from press releases from company websites. The majority of price stabilisation takes place in the beginning of the thirty days. From day eighteen the number of companies in our sample that are being stabilised sharply declines. No company is stabilised past their twenty-third day of trading.

In order to better understand the nature of the overallotment options observed in our sample, we also calculate an indicative valuation using the Black-Scholes option pricing formula as inspired by Hansen et al. (1993) and Bajo et. al (2017). Although, the Black-Scholes formula cannot perfectly estimate the price of the overallotment option, as previously discussed, we argue that the indicative valuation will be informative to understand the real value of the overallotment option and therefore add flavour to our subsequent discussion and analysis.

With regards to our inputs in the Black-Sholes formula, we compute the annualized return volatility using the estimated return volatility for the first 30 days of trading. Additionally, we define the time to maturity as 41 calendar days as this is the average number of calendar days for a time period of 30 trading days. It is worth noting that there are some issues with using ex-post data for an ex-ante valuation. However, we believe this method of parameter estimation is valid for indicative purposes, as no ex-ante data regarding volatility exists and we prefer using idiosyncratic information for individual companies. Additionally, we define the option's strike price as the listing price minus the gross spread, since this is the price the underwriter pays if the option is exercised. As the gross spreads to the underwriter is normally not made public, we value the option using the range of 2 to 7 percent that is commonplace as the gross underwriter spread in an IPO, hence yielding a valuation range in relation to the total equity offering as presented in Table 5 below.

Table 5: Overallotment option value as a share of the total issue size

Gross spread	2%	3%	4%	5%	6%	7%
Max	0.71%	0.80%	0.89%	0.99%	1.10%	1.21%
Min	0.21%	0.30%	0.40%	0.50%	0.60%	0.70%
Mean	0.36%	0.48%	0.60%	0.73%	0.87%	1.01%
Median	0.34%	0.47%	0.60%	0.75%	0.90%	1.05%

Note: The table presents summary statistics of the values of the overallotment options in our sample, in relation to different assumptions regarding the underwriter gross spread. Time to maturity for the options is set to 41 days, volatility is estimated using the sample volatility of daily returns for the initial 30 days of trading, the risk-free rate is set to 0% given the prevailing zero-interest rate climate and the strike price is set to listing price minus the gross spread. Note that option values are presented as a value in relation to gross proceeds.

5. Methodology

5.1 The effect of price stabilisation on the bid-ask spread

In this section we present our methodology for estimating the impact of price stabilisation on the bid-ask spread. Firstly, we run several pooled cross-sectional regression models, in which the bid-ask spread is regressed on a proxy for price stabilisation and a set of control variables. Secondly, we perform a similar regression in which we replace the stabilisation proxy with an empirical stabilisation dummy.

5.2 Cross-sectional regressions

In order to measure the impact of the price stabilisation on new issues, we draw inspiration from Chung et al. (2000) Bajo et al. (2017) and Hanley et al. (1993). The latter deploy a set of cross-sectional regressions where the bid-ask spread is modelled as a function of an underwriter stabilisation proxy that should theoretically be significant if price stabilisation is evident, controlling for a set of control variables detailed below. In the study carried out by Hanley et al., a total of 30 separate cross-sectional regressions are used, one for each of the first 30 days of trading. By doing so, the authors are able to determine if potential effects are ceasing over time. This model is however not suitable for our study given that our sample is relatively limited in size. Therefore, we deploy six different pooled cross-sectional regression models. The six regression models are pooled for the time periods, in the following split: days 1 to 5, 6 to 10, 11 to 15, 16 to 20, 21 to 25 and 26 to 30. When pooling, each variable can be estimated for a larger number of observations, which is an advantage given our limited sample size. In addition, the windows are short enough to examine if the effect of price stabilisation is present only in the early phase of the initial aftermarket trading or present for longer periods of time. We also control for several variables with documented effect on the bid-ask spread, as proposed by Copeland & Galai (1983), Chung et al., and Hanley et al. These include share turnover, share price, return volatility and the number of underwriters in the underwriting syndicate. Given that we make use of both a stabilisation proxy and a stabilisation dummy to examine the impact of stabilisation, the two following cross-sectional regression models are estimated for each five-day period during the initial 30 days of trading.

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Proxy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Dummy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

Where $RBAS_{i,t}, Proxy_{i,t}, Dummy_{i,t}$ and $Turnover_{i,t}$ are the relative bid-ask spread, stabilisation proxy value, stabilisation dummy and turnover for company i in trading day t, $Volatility_i$ is the volatility during the five-day windows for firm i and $Underwriters_i$ is the number of underwriters in the underwriting syndicate for firm i. Similarly to Hanley et al., we specify a log-log model where the dependent variable and independent variables are logarithmically transformed. The reason for choosing a log-log specification is threefold. Firstly, the distributions of our dependent variable bid-ask spread, and independent variables volatility, price and market makers are all positively skewed, why a logarithmic transformation yields less skewness on both the left- and right-hand side of the equation. Secondly, the log-log specification has been used by for example Hanley et al. (1993) and Chung et al. (2000), which makes this study more comparable to previous research. Lastly, logarithmic transformations help mitigate potential distortion from outlying observations. Given the log-log specification, coefficients will be interpreted as elasticities, namely how a percentage change in one explanatory variable explains effects on the dependent variable in percentage terms.

5.3 The stabilisation proxy

Hanley et al. (1993) use a proxy for underwriter stabilisation defined as the distance between the closing bid price and the listing price per company and day. The proxy is meant to quantify the likelihood of an underwriter engaging in price stabilisation activities, where a relatively low value indicates high likelihood of stabilisation. The rationale for this proxy is that underwriter activities in the aftermarket should be more common close to, or below, the listing price. The ex-ante expectation would thus be that the bid-ask spread should be narrower when the stabilisation proxy is low, while the opposite should be true for larger values of the proxy. We define the stabilisation proxy for company i during trading day t as the logarithmically transformed ratio between the average bid price during day t and the offering price at which the issue was listed for company i:

$$Proxy_{i,t} = \ln\left(\frac{\frac{1}{n_{i,t}}\sum_{j=1}^{n_{i,t}}(Bid_{i,t,j})}{Offering\ price_i}\right)$$

Where $Bid_{i,t,j}$ is the highest bid price for company i, during trading day t at transaction j, $n_{i,t}$ is the number of transactions for company i during trading day t, and $Offering\ price_i$ is the price at which the issue was listed for company i.

As previously outlined in Section 3, our first hypothesis states that the bid-ask spread will be narrower for shares trading slightly above, or below, their listing prices compared to shares trading far above the listing price (i.e. lower values of the stabilisation proxy should correlate with narrower bid-ask spreads). To test this hypothesis, we use the full sample of observations and run the pooled cross-sectional regression model using the stabilisation proxy.

Adding to this, our second hypothesis states that the bid-ask spread will be narrower for shares trading close to their listing prices compared to shares trading far above their listing prices. In order to test this hypothesis, we assume that there is a hypothetical *floor price* defined as the lowest share price an underwriter will accept before it utilises the full stabilisation potential given by the overallotment option. We then divide the sample into two groups, depending on if the share is trading above (AFP) or below (BFP) the specified floor price, and deploy the same pooled cross-sectional regressions with the same time windows as for Hypothesis I. Moreover, for our AFP and BFP regressions, we use different floor prices for robustness purposes.

5.4 The stabilisation dummy

Even though the stabilisation proxy proposed by Hanley et al. (1993) is one of the most commonly used methods to understand price stabilisation, we believe there are some flaws with the proxy. Although price stabilisation is plausibly more likely below or close to the listing price, there may be other effects that apply to shares depending on their share price development, which also affect the width of the bid-ask spread. This issue is discussed by Hanley et al., who argue that there is a possibility that the stabilisation proxy might capture effects related to adverse selection. In this context, adverse selection refers to a scenario where well-performing stocks attract more informed investors and consequently market makers widen their quoted bid-ask spread in order to reduce risk. That market makers quotes wider bid-ask spreads when there are more informed traders is documented by for example Copeland & Galai (1983). Additionally, we previously outlined that the proxy may also capture effects relating to selling pressure that could be evident for poorly performing stocks. With this in mind, we use our collected data on the timing of price stabilisation to construct a dummy variable for every share and trading day that shows whether stabilisation occurred or not. We then replace the stabilisation proxy with the empirical dummy variable, as described in Section 5.2, and deploy the cross-sectional regression model on the full sample of observations to test our third hypothesis. The dummy variable provides additional depth in the analysis of the impact of stabilisation on the bid-ask spread, which helps in both validating results using the stabilisation proxy but also in providing more insights. Note that in this regression we do not divide our sample based on share price performance, as we now know whether a stock is stabilised. The dummy for company i during trading day t is defined as:

$$Dummy_{i,t} = \begin{cases} 1, If\ the\ share\ is\ stabilised \\ 0, If\ the\ share\ is\ not\ stabilised \end{cases}$$

However, there are some drawbacks with the empirical dummy variable. Firstly, it only considers whether the share is stabilised or not and does not account for the volume that is stabilised. The impact of stabilisation should reasonably depend on the number of shares that are purchased for stabilisation purposes. The reason for not creating a variable that includes stabilisation volume is that only a few companies announce information regarding the number of shares that were purchased for stabilisation purposes per day of stabilisation. The second drawback is that the dummy only accounts for companies and days where there are stabilising trades and excludes companies where there are only stabilising quotes. For example, if an underwriter quotes higher bid prices than other agents in order to mitigate the potential share price decline in the case of a sell-off, this will not be considered as stabilisation if the quote never results in a trade. Similarly, the variable does not take into account that shares trading closely above the listing price may face an indirect effect of stabilisation. As previously discussed, these shares may have narrower bid-ask spreads than others as investors face less risk if they anticipate underwriter stabilisation in the event of a price decline, which allows them to quote higher bid-prices than they would normally do. Nonetheless, the dummy still gives a good indication regarding the effect of stabilisation on the bid-ask spread.

5.5 Regression variables

Prior research has frequently used the quoted bid-ask spread at the end of the trading day in their analyses of the impact on the bid-ask spread. However, McInish & Wood (1992) among others document that bid-ask spreads tend to be higher in the beginning and the end of the day, relative to the interior period. This may cause some distortion in using only the end-of-day quoted bid-ask spread as the relevant measure. In comparison to previous research, we calculate the daily average relative bid-ask spread for every company for each of the first 30 days of trading, using intraday data where bid- and ask prices are recorded when every transaction takes place. This gives us more granularity in our analysis, and a more accurate estimate of the bid-ask spread that prevails during the majority of each trading day. The average relative bid-ask spread for a company i during trading day t, $RBAS_{i,t}$, is defined as the difference between the ask price and the bid price, divided by the mid-point price:

$$RBAS_{i,t} = \frac{1}{n_{i,t}} \sum_{j=1}^{n_{i,t}} \frac{Ask_{i,t,j} - Bid_{i,t,j}}{\frac{Ask_{i,t,j} + Bid_{i,t,j}}{2}}$$

Where $Ask_{i,t,j}$ and $Bid_{i,t,j}$ is the highest ask price and the highest bid price for company i, during trading day t at transaction j and $n_{i,t}$ is the number of transactions for company i during trading day t.

The price of a stock may have an effect on the relative bid-ask spreads if the difference between ask- and bid prices is independent of the price. Thus, we control for this potential effect by including a variable capturing the average price level for company i at trading day t. The price variable is defined as:

$$Price_{i,t} = \frac{1}{n_{i,t}} \sum_{j=1}^{n_{i,t}} Transaction\ Price_{i,t,j}$$

Where $Transaction\ Price_{i,t,j}$ is the transaction price for company i, during trading day t at transaction j and $n_{i,t}$ is the number of transactions for company i during trading day t.

Another variable that has a documented effect on the bid-ask spread is volatility. High volatility tends to increase the bid-ask spread, as market makers and other agents face increasing risks. However, in the initial aftermarket, volatility can differ substantially between trading days. Therefore, only one measure of volatility is computed for every company over each five-day window. The volatility for company i during time period k is defined as the annualised return volatility, using daily returns:

$$Volatility_{i,k} = \sqrt{\frac{\sum_{i=1}^{n_k}(r_{i,t} - \overline{r_{i,k}})}{n_k - 1}} \times \sqrt{\frac{252}{n_k}}$$

Where $r_{i,t}$ is the return for company i during trading day t, n_k is the number of days in time window k and $\overline{r_{i,k}}$ is the mean return for company i during time window k.

The last explanatory variable that we control for is the number of underwriters in the underwriting syndicate. In previous research, the *number of market makers* has been shown to reduce the bid ask spread. However, as we lack access to exact data on market makers, we use a proxy of the number of market makers defined as the number of underwriters in the underwriting syndicate, which typically reflects the number of market makers in the initial aftermarket (Ellis, 2000). Number of underwriters also correlates strongly with the size of the company, and therefore we decide to leave out size-based control variables.

5.6 Evaluating the feasibility of the models

When using OLS regressions there are a couple of assumptions that need to be satisfied and controlled for in order to produce unbiased and efficient estimates of the regression coefficients:

Assumption I: $E(\varepsilon_{i,t}) = 0$

Assumption II: $Var(\varepsilon_{i,t}) = \sigma_{\varepsilon_i}^2$

We analyse the distribution of the residuals for our regressions and conclude that the residual distributions have expected values of zero and exhibit no significant skewness, however some kurtosis. Moreover, in order to control for heteroskedasticity we run all regressions using robust standard errors. We also control for multicollinearity between our independent variables by computing a correlation matrix for our variables, presented in Table A2 in the Appendix. From these tests, we can safely conclude that our model specification does not suffer from multicollinearity, as none of the independent variables have a correlation stronger than 0.34.

6. Results and discussion

6.1 Regression results for the stabilisation proxy

In the below table, we present our empirical results from our pooled cross-sectional regressions for the initial 30 days of trading, using the stabilisation proxy. Firstly, applying the full sample to our regression model. Secondly, using the sample data on shares trading above the hypothetical floor price (AFP). Thirdly, we present the results from our regression using the sample data on shares trading below the hypothetical floor price (BFP). Below in Table 5.1 we have summarised the results for the price stabilisation proxy, using the various sub-samples. For more detailed results from the regression, see Table A3, Table A4 and Table A5 in the Appendix. Given that we have specified a log-log model, coefficients should be interpreted as elasticities. This means that the coefficient refers to the relative percentage change in the relative bid-ask spread, for a percentage change in the stabilisation proxy. Given the regression model specification, a positive coefficient on the stabilisation proxy indicates that the relative bid-ask spread is wider for higher (more positive) values of the stabilisation proxy, whereas a negative coefficient indicates that the relative bid-ask spread is wider for lower (more negative) values of the stabilisation proxy. For all regressions, we control for heteroscedasticity by using robust standard errors.

Table 6: Regression results using the stabilisation proxy

Model		Floor Price = 0.98P*						Floor Price = 1.00P*					
Day		1-5	6-10	11-15	16-20	21-25	26-30	1-5	6-10	11-15	16-20	21-25	26-30
Proxy coefficients	Full	0.49 **	-0.02	-0.44 **	-0.44 *	-0.30	-0.26	Same as for Floor Price = 0.98P*					
		(0.18)	(0.18)	(0.17)	(0.20)	(0.17)	(0.15)						
	AFP	0.81 ***	0.22	-0.28	-0.06	-0.09	0.39	0.58 *	0.22	-0.23	-0.03	-0.13	0.29
		(0.23)	(0.23)	(0.26)	(0.27)	(0.26)	(0.25)	(0.23)	(0.27)	(0.29)	(0.31)	(0.28)	(0.25)
	BFP	-1.31	0.65	0.09	0.44	-1.64 *	-1.34 *	-1.16	-1.31	-0.88	-0.46	-1.43 *	-2.29 ***
		(0.99)	(1.54)	(0.61)	(0.73)	(0.64)	(0.53)	(0.89)	(1.01)	(0.50)	(0.60)	(0.59)	(0.47)
Obs.	Full	365	365	365	365	365	363	365	365	365	365	365	363
	AFP	304	303	283	274	269	271	253	245	242	244	241	251
	BFP	61	62	82	91	96	92	112	120	123	121	124	112
Adj. R^2	Full	0.25	0.16	0.30	0.21	0.28	0.26	0.25	0.16	0.30	0.21	0.28	0.26
	AFP	0.33	0.20	0.40	0.28	0.29	0.29	0.29	0.22	0.43	0.28	0.28	0.27
	BFP	0.23	0.07	0.12	0.17	0.34	0.44	0.20	0.16	0.09	0.15	0.32	0.39
Standard errors		Robust						Robust					

*** p < 0.001; ** p < 0.01; * p < 0.05

Note: The table presents a summary of the coefficients of the stabilisation proxy, depending on sub-sample and floor price. For full regressions see Table A3, A4 and A5 in the Appendix. "Full" refers to the full sample regression, "AFP" refers to the sample trading above the floor price and "BFP" refers to the sample trading below the floor price. Note that there are two missing observations in the days 26-30, as there was no trading in two companies during one trading day. P-values are based on two-sided coefficient tests, using robust standard errors. P* refers to the listing price. The model specification for the regressions is:

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Proxy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4\, \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

6.1.1 Full sample regression

To test Hypothesis I, we run our regression model based on the stabilisation proxy on the full sample of IPOs. The results from the regression indicates that our price stabilisation proxy exhibits a positive effect with a coefficient of 0.49 on our dependent variable, the bid-ask spread, that is significant at the 1 percent level in the first five days of trading. In the following period, including sample data for the time period including days 6-10, the coefficient for our price stabilisation proxy becomes statistically insignificant. In the two following periods, days 11-15 and 16-20, the effect of our price stabilisation proxy again becomes significant at the 1 percent level and 5 percent level, respectively, and the coefficient changes sign to -0.44. In the last two periods, the coefficient of the price stabilisation proxy remains negative but statistically insignificant. For our six regressions using the full sample, our number of observations range between 363 and 365. The adjusted R-squared ranges between 0.16 and 0.28 for the full sample.

For the first five days in our full sample regression, our proxy indicates that poorly performing companies have narrower bid-ask spreads. However, the results for days 11-20 indicate that companies experiencing a positive share price development have narrower spreads. The latter is counterintuitive and cannot be explained by price stabilisation measures from the underwriters, because of the regulatory environment surrounding price stabilisation. We see two potential explanations for why the stabilisation proxy coefficient assumes a statistically significant negative value for these two periods. Firstly, it may be that companies that experience positive share price developments have narrower spreads. However, this does not seem to be the case given the results from the AFP regression, analysed in more detail below. Secondly, it may be that poorly performing stocks have wider spreads, where selling pressure is too extensive for stabilisation to successfully counter a negative market sentiment driving down a stock's price. Differently put, there is a risk that there is omitted variable bias and that the price stabilisation proxy captures effects on the bid-ask spread other than price stabilisation. Given the counterintuitive results, we do not provide conclusive evidence for Hypothesis I. These findings are contrasting to the findings of Hanley et al. (1993). Also, in comparison to the results of Chung et al. (2000), our results from the full sample regression are too ambiguous for us to draw conclusions with regards to stabilisation. Therefore, we believe that our reasoning leading to Hypothesis II adds additional depth to understand the impact of the stabilisation on the bid-ask spread.

6.1.2 Above floor price (AFP) regression

To test Hypothesis II, we first run our regression on a limited set of the sample data, including only those observations exhibiting a price development of at worst negative two percent from the listing price. This regression yields different results regarding the effect of the stabilisation proxy, in comparison to the full sample regression. In this case, we see that the stabilisation proxy becomes significant at the 0.1 percent level with a positive coefficient of 0.81 during the first five days. Thereafter, the statistical significance of the proxy disappears. Though directionally, we observe that it assumes a negative coefficient between days 11 through 25. For days 26 to 30, the coefficient again changes sign, but remains statistically insignificant. When running this regression, our sample size ranges between 271 and 304 observations across the time periods and the adjusted R-squared ranges between 0.20 and 0.40, indicating that the model is informative and can help explain the variance in the bid-ask spread. Regarding the magnitude of the effect in the initial five days in the aftermarket, the stabilisation proxy coefficient implies that a share trading at its listing price experiences an approximate decrease of 0.8 percent in the width of the bid-ask spread compared to a share trading 1 percent above its listing price.

When we adjust the assumption regarding the floor price, we observe that the price stabilisation proxy exhibits a positive coefficient of 0.58 for the first five days, that is statistically significant at the five percent level. For the remaining time periods, we find no support for the price stabilisation proxy being statistically different from zero, although we observe that the coefficient between days 6 to 10 are directionally in line with our findings from our first AFP regression, with a coefficient of 0.22. Between the days 11 to 25, the coefficients, albeit insignificant, exhibit a similar pattern to that of the first AFP regression, all assuming negative values. The same holds true for days 26 to 30 where the coefficient for our price stabilisation proxy again has a positive sign, though not statistically separated from zero. Our sample size when employing this limitation to our dataset ranges between 241 and 253 observations, with an adjusted R-squared in the range of 0.22 to 0.43.

Interestingly, when we limit our sample to only include stocks trading above the floor price, the price stabilisation proxy has a statistically positive effect on the bid-ask spread for the initial five days of trading. This means that lower values of the proxy are related to narrower bid-ask spreads. With these results we conclude that Hypothesis II appears to hold true, although only for days 1 to 5. This finding is also consistent with the notion that there is an effect on the bid-ask spread when price stabilisation should be most evident, which also explains why the effect becomes insignificant in the later periods. These findings are concurrent with those of Hanley et al. (1993), although for a shorter time frame, and in contrast with those of Chung et al (2000). Moreover, comparing our findings using different floor prices in the regression, we note that the effect of the stabilisation proxy is substantially more significant and the adjusted R-squared increases when we include the observations that are most likely to be stabilised, i.e. those trading in the range between two percent below the listing price and the listing price. It should therefore be highlighted that when these data points are added to the sample, the stabilisation proxy seems to have a more pronounced impact on the bid-ask spread. This finding supports the intuition behind Hypothesis II, that the bid-ask spread should be narrower for stocks trading closely to the listing price than those far above, as those are more likely influenced by price stabilisation.

6.1.3 Below floor price (BFP) regression

As mentioned in the methodology section, we also limit our sample in use to only include observations that exhibits a negative share price development relative to their listing price in the first thirty days of trading. We first run our pooled cross-sectional regressions on the sample including only observations that have performed up to a negative two percent decline from the listing price. Subsequently, this is followed by a regression using observations trading below the listing price.

For the first BFP regression, our empirical study yields vastly different results from the previously specified models. In this case, the stabilisation proxy cannot be said to exhibit an effect on the width of the bid-ask spread that is statistically different from zero on any occasion for the initial 20 days of trading. However, the sign of the coefficient is negative for the first time period, followed by being positive for the subsequent three. In the last two time periods, the proxy becomes statistically significant at the five percent level, assuming a coefficient of -1.64 and -1.34, respectively. For this sub-sample, our sample size ranges from 61 to 96 across the time periods. The adjusted R-squared ranges between 0.07 to 0.44.

When running the BFP regression with the floor price equal to the listing price, we observe that the stabilisation proxy remains directionally negative but statistically insignificant in the first four time periods. For the last two time periods, the stabilisation proxy is significant at the five percent level and the 0.1 percent level, respectively. The coefficients in this case are strongly negative, ranging between -1.43 and -2.29. In this regression, our number of observations ranges between 112 and 124 and the adjusted R-squared between 0.09 and 0.39.

While we do not explicitly test any hypothesis on our BFP sample, we discuss in our intuition behind Hypothesis II, that the proxy will not work equally well for this sample. From our regressions using this sample, we do indeed collect results that are directionally in line with that intuition. Looking at the regression where the floor price is set to the listing price, the results yield a directionally negative, however not significant, effect of the price stabilisation proxy in the initial twenty days of trading. For the final ten days, this effect becomes statistically significant. Our results indicate that shares trading closely to the floor price exhibit a narrower bid-ask spread, and conversely, that poorly performing companies have wider spreads. From a perspective of price stabilisation, this is counterintuitive since worse-performing shares should be more stabilised. One possible explanation to this could be that selling pressure on the stock is too extensive to counteract via price stabilisation, following the previously discussed reasoning regarding the drawbacks of the proxy. This may then have a widening effect on the bid-ask spread, as investors and market makers are becoming more concerned about the risks of quoting orders in a failing issue. This effect is then potentially captured by the stabilisation proxy, making it difficult to draw any conclusions regarding price stabilisation in isolation. Whether or not this is the case, we leave to future researchers to delve deeper into. Additionally, it would be interesting to understand if stabilisation is countering the selling pressure during the first twenty days of trading, and that this is the reason why the negative coefficient becomes significant around the time when price stabilisation ceases (i.e. around day 20, see Chart 4).

6.2 Regression results for the stabilisation dummy

In Table 7 below, we present our empirical results from using the stabilisation dummy on the full sample of companies. Since the dependent variable, the relative bid-ask spread is logarithmically transformed, coefficients on the dummy variable should be interpreted as the relative percentage change in the relative bid-ask spread if a share is stabilised compared to if it is not. Intercept coefficients are left out intentionally, as well as results for days 26 to 30 since no stabilisation occurred during this period of time. A negative coefficient on the stabilisation dummy indicates a narrowing effect on the bid-ask spread, whereas a positive coefficient indicates a widening effect. In addition, we use robust standard errors for this regression to mitigate risk of heteroskedasticity in our data.

Table 7: Regression results using the stabilisation dummy

Day	1-5	6-10	11-15	16-20	21-25	26-30
Stabilisation dummy	-0.11 *	-0.03	0.05	-0.01	-0.26	Not applicable
	(0.05)	(0.06)	(0.06)	(0.07)	(0.16)	
Volatility	0.17 ***	0.06	0.19 ***	0.15 ***	0.31 ***	
	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	
Turnover	-0.09 ***	-0.07 **	-0.15 ***	-0.10 ***	-0.12 ***	
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	
Price	-0.16 **	-0.05	-0.16 *	-0.17 *	-0.25 ***	
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	
No. of underwriters	-0.05	-0.33 ***	-0.40 ***	-0.40 ***	-0.35 ***	
	(0.06)	(0.06)	(0.07)	(0.08)	(0.08)	
N	350	350	350	350	350	
R^2	0.23	0.13	0.26	0.18	0.27	
Adj. R^2	0.22	0.12	0.25	0.17	0.26	
Standard errors	Robust					

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Note: The table presents a summary of the coefficients of the stabilisation dummy and control variables for the full sample. For this regression, three companies were left out of the sample since information on when stabilisation occurred could not be found. These were 8TRA, NOBINA and COOR. Hence the regression is estimated using 70 out of 73 companies in our sample. Days 26-30 show no results, since no stabilising trades occurred during these days. P-values are based on two-sided coefficient tests, using robust standard errors. The model specification for the regressions is:

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Dummy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

We find that the stabilisation dummy has a directionally narrowing effect on the bid-ask spread throughout all time periods except for days 11 to 15. However, the effect of the stabilisation dummy is statistically significant only in the first five days of trading. Interestingly, this pattern exhibits similarities to the results from the AFP regressions. Considering the magnitude of the effect from using the stabilisation dummy, stabilised companies experience an approximate 11 percent relative decrease in the bid-ask spread during the first five days of trading on average. The adjusted R-squared ranges between 0.13 and 0.27.

For the results using the dummy variable, we find that stabilisation has a narrowing effect on the bid-ask spread and similarly to the results from the AFP regression, the effect is only evident during the first days of trading. With regards to Hypothesis III, we find evidence in support of stabilised companies having narrower bid-ask spreads for the initial five days of trading, albeit the effect wanes and becomes insignificant as time progresses.

In comparison to the analyses using the stabilisation proxy, the dummy analysis allows us to isolate the effects of price stabilisation, which both adds granularity and mitigates the risk of suffering from omitted variable bias. Interestingly, the results from using the dummy variable also indicates that the impact of stabilisation ceases after the first five days of trading. This is indeed remarkable given that companies are being stabilised for up to 20 days of trading. However, an explanation could be that the dummy does not consider how extensive the stabilisation is. In other words, it may be that even though there are stabilising trades in several companies after day five, these trades make up relatively less volume in relation to the total turnover in the share compared to the first five days of trading. Consequently, the effect of stabilisation diminishes over time even though shares are still stabilised.

7. The implications of our results

To conclude, the results differ between the AFP sample and the full sample. With this said, the findings in the AFP regression are in line with the conclusions from Hanley et al. (1993). In the full sample however, we argue that the stabilisation proxy may not be as generalisable as previously conceived and that either the proxy itself warrants modification, or that its usage will have to depend on the sample data in use. This notion is particularly evident when considering the results from the BFP regression. With this in mind, we remain reluctant to draw any definitive conclusions regarding the stabilisation proxy's usefulness in determining whether price stabilisation has a narrowing effect on the bid-ask spread, at least for the full sample- and BFP regressions. However, we find that the results from the AFP regression support the hypothesis that the bid-ask spread is narrower for issues trading closely to their listing price. Following the logic of Hanley et al. (1993) and Chung et al. (2000), this provides evidence in favour of price stabilisation exhibiting a narrowing impact on the bid-ask spread.

We believe that the results from the AFP regression and the regression using the empirical dummy variable are complementary in understanding the impact of price stabilisation on the bid-ask spread. The reason why neither of the two analyses are collectively exhaustive is because both have flaws, as previously outlined. However, where the proxy fails to consider when stabilisation occurs, the dummy is able to demonstrate exact dates of stabilisation. Furthermore, where the dummy fails to predict which companies are subject to more extensive stabilisation, the proxy provides a good indication. Therefore, we believe that having the two tests yielding similar results allows us to confidently argue that price stabilisation does have an impact on the bid-ask spread in the first five days of trading. Consequently, we conclude that we find evidence in support of Hypothesis II and Hypothesis III for the first five days of trading, whereas we cannot find evidence in support of Hypothesis I. Given this evidence, we argue that stabilisation has an impact in the initial aftermarket of new equity offerings, which is in line with the conclusion of Hanley et al. but contrasting to the conclusion of Chung et al.

The stabilisation proxy can provide insights as to whether the effect of stabilisation is evident or not, albeit the analysis regarding the magnitude of the effects is less intuitive on an aggregate level. This is explained by the proxy being a non-binary variable, whereas stabilisation is binary. However, by using the dummy, we can infer that stabilised companies experience an average decrease of 11 percent in the width of the bid-ask spread during the first five days of trading. The average bid-ask spread for all companies during these days was 0.46

percent (see Table 3). Assuming that the decrease in the width of the bid-ask spread is derived only from an increase in the bid price, provided that this is the expected effect of stabilisation activity, then this means that bid prices for stabilised shares on average are 0.05 percent higher than they would have been without stabilisation.[2] Although the magnitude from our results is limited, it is worth clarifying that the benefits of stabilisation arguably go beyond narrower bid-ask spreads. These benefits include potential share price increases as well as lower volatility. However, given the ambiguity in prior research, the aim of this study is to examine whether price stabilisation has any measurable impact at all. Consequently, the study does not focus on the magnitude of the impact.

Although our findings indicate that price stabilisation has an impact on bid-ask spreads, it is debatable whether the continued usage of the overallotment option is warranted. Firstly, the effect of stabilisation is only present for the first days of trading. Moreover, we find indications that stabilisation does not seem to exhibit an effect on the worst-performing stocks, which is plausibly when stabilisation is needed the most. Also, given the substantial costs for the issuer that stems from the overallotment option, it is important for the underwriter that the perceived benefits from stabilisation warrants the costs of the option. If this is not the case, the investment banking industry would do well in aligning their incentives with the issuer, for example by splitting potential profits derived from aftermarket short covering with the issuer.

[2] The 0.05 percent increase in bid prices is derived from the calculation: $Average\ RBAS\ x\ \beta_{Dummy} = 0.46\% \times 11\% = 0.05\%$

8. Conclusion

This paper aims to better understand the impact of the overallotment option and corresponding stabilising activities on new issues. We do so by studying whether price stabilisation exhibits an effect on the relative bid-ask spreads in the initial aftermarket trading. We gather data on 73 IPOs taking place on the Nasdaq Stockholm main markets and collect information regarding the size and exercise of the overallotment option, as well as intraday trading information about bid prices, ask prices, transaction volumes and transaction prices. To measure the effect of stabilisation activities on the bid-ask spread, we make use of a proxy proposed by Hanley et al. (1993), which allows us to assess the likelihood of stabilisation. In addition to the proxy, we propose amendments to its usage as well as the introduction of a stabilisation dummy variable, which is based on empirical observations of underwriters engaging in stabilising activities. We then run several pooled cross-sectional regressions in order to establish whether price stabilisation has a pronounced impact on the bid-ask spread.

Using the stabilisation dummy and the stabilisation likelihood proxy, we find that stabilisation activities do have a narrowing effect on the bid-ask spread, albeit limited to approximately five days in the initial aftermarket trading. These findings are in line with Hanley et al. and in contrast with Chung et al. (2000). In addition, our study contributes to research with new insights. Firstly, we find that there could be drawbacks with the commonly used stabilisation likelihood proxy, which makes it less generalisable than previously conceived. Secondly, the stabilisation dummy allows us to conclude that the effect of stabilisation is limited to only the first five days of trading, even though companies are being stabilised for up to 20 days of trading, for our sample.

Conclusively, we argue that despite our findings that the overallotment option seems to have an effect in terms of price stabilisation, the overallotment option still warrants additional scrutiny because of the incremental costs of flotation that stems from its inclusion. Further research is needed to better understand the effects of stabilisation and other potential benefits in order to justify the use of the option.

9. Limitations and future research

9.1 Limitations

For our initial sample of main market IPOs on the Stockholm Stock Exchange, only four listings did not include an OAO. Due to the small sample size of IPOs excluding an overallotment option, any test that is based on comparisons between IPOs including OAOs and IPOs excluding OAOs is difficult to carry out. Although it would be possible to get data for a sample of IPOs without overallotment options by also taking IPOs from a longer time frame, the Nasdaq HFT database only includes data from 2010 and forward. Additionally, for example *First North* data would not be suitable to use as a comparison, as these IPOs are less regulated than those on the main markets. The regulatory differences may influence the bid-ask spread, and we believe it would be challenging to construct a test to control for them.

Furthermore, to draw any general conclusion as to whether the stabilisation has any effect on the bid-ask spread or not, one would preferably use a data sample that is representable for all IPOs. We use a Swedish sample between 2010 to 2019, therefore one should be wary in generalising our results to other geographies and time frames, although we believe that our study adds important insights with regards to the Swedish IPO-market.

In terms of methodology, our pooled cross-sectional regressions may have drawbacks in terms of the analysis it allows us to perform. Although we believe pooling is necessary given our limited sample, coefficients are calculated as an average over blocks of five trading days. This makes it difficult to say if coefficients are distorted by outlying data during a specific trading day that we cannot see. In addition, we are also not able to establish if the coefficients differ dramatically between days in each pooled cross section. Moreover, our results are based on a stabilisation proxy and an empirical stabilisation dummy, where we have discussed drawbacks with both. Especially the former may potentially suffer from omitted variable bias, as we have discussed other effects that may correlate with this proxy that also influences the bid-ask spread, such as selling pressure and adverse selection. Lastly, results may be affected by the chosen floor price. Changing this floor price could potentially lead to other conclusions.

In terms of data collection, much of the data used in this study is collected manually. We humbly accept that there is a risk of human errors when mapping data manually, however we believe there are no mistakes and if there are any, we take full responsibility.

In the sections leading up to this, shortcomings of the proxy and the dummy in use in this study have both been discussed. Starting out with the stabilisation proxy, we find indications that it may be less useful than previously conceived, albeit additional understanding as to how the proxy behaves in different contexts and varying datasets are required before drawing definitive conclusions. Moreover, in the usage of our stabilisation dummy variable, we highlight that it lacks nuances being a binary variable. A preferable use case would have been to also consider the extensiveness of the stabilisation that was carried out. However, due to lack of data showcasing the necessary granularity, we leave this to future research.

Lastly, our study is intentionally limited to assess the impact that the overallotment option, and the price stabilising activity that comes with it, has on the bid-ask spread. This means that we shed light on the value of the overallotment option by viewing it from the lens of its effects on the bid-ask spread, why the discussion should be interpreted as such. There may very well be other benefits or costs to the issuer or underwriter if one pursues an analysis focusing on for example the share price development, or its effect on the volatility of the stock.

9.2 Suggestions for future research

Due to the ambiguous results from studies within this field of research, more studies are needed in order to reach a more conclusive understanding as to whether the inclusion of the overallotment option and the corresponding price stabilisation activities have any effect on the bid-ask spread. We see room for more studies which are based on empirical evidence as opposed to proxies of stabilisation. In our study we propose the usage of a stabilisation dummy, and we believe future research should focus on also incorporating the volume that is being stabilised per day, in addition to our dummy variable.

We believe it would be of interest to examine the effects of the overallotment option on post-IPO share price performance as well as on stock price volatility. As per our discussion in the limitations segment, our study is limited to study the effect of price stabilisation on the bid-ask-spread. To further expand the understanding of the overallotment option in the IPO context, these are additional angles we propose to better inform decision making going forward. In our study, we have refrained from doing this because of the potential endogeneity problems that may arise, as the proxy in use is heavily dependent on price development by construction. With more empirical approaches to estimate the OAO effect, this type of study becomes viable. It would also be of interest to perform more longitudinal studies on the effect of the overallotment option on companies going public, to further understand whether the effects it may have are persistent over time. If the issuer benefits from price performance increases and lower volatility, this could provide evidence for proponents of the overallotment option.

As touched upon in the limitations section of this paper, comparable studies across different markets would also be of interest, whether comparing cross-border or between main markets and smaller exchanges. By adding this to the existing body of research, academia would come closer to more conclusive results about the overallotment option and price stabilisation, thereby supporting management teams in companies going public with more decision-making material to allow for more informed decisions in the process of going public.

10. References

Aggarwal, R. (2000). Stabilization Activities by Underwriters after Initial Public Offerings. *The Journal of Finance*, 55(3), pp.1075-1103.

Bajo, E., Barbi, M. and Petrella, G. (2017). Do firms get what they pay for? A second thought on over-allotment option in IPOs. *The Quarterly Review of Economics and Finance*, 63, pp.219-232.

Black, F. and Scholes, M. (1973). The Pricing of Options and Corporate Liabilities. *Journal of Political Economy*, 81(3), pp.637-654.

Boehmer, E. and Fishe, R. (2004). Underwriter short covering in the IPO aftermarket: a clinical study. *Journal of Corporate Finance*, 10(4), pp.575-594.

Chung, R., Kryzanowski, L. and Rakita, I. (2000). The Relationship Between Overallotment Options, Underwriting Fees and Price Stabilization For Canadian IPOs. *Multinational Finance Journal*, 4(1/2), pp.5-34.

Copeland, T. and Galai, D. (1983). Information Effects on the Bid-Ask Spread. *The Journal of Finance*, 38(5), pp.1457-1469.

Ellis, K., Michaely, R. and O'Hara, M. (2000). When the Underwriter Is the Market Maker: An Examination of Trading in the IPO Aftermarket. *The Journal of Finance*, 55(3), pp.1039-1074.

Finansinspektionen. (2007). DNR 07-1233-308. *Processen vid nyintroduktioner och emissioner.* 2007:11.

Franzke, S., Schlag, C. (2003). Over-Allotment Options in the Ipos on Germany's Neuer Market – an Empirical Investigation. *EFMA 2004 Basel Meetings Paper; CFS Working Paper No. 2002/16.*

Hanley, K., Kumar, A. and Seguin, P. (1993). Price stabilization in the market for new issues. *Journal of Financial Economics*, 34(2), pp.177-197.

McInish, T. and Wood, R. (1992). An Analysis of Intraday Patterns in Bid/Ask Spreads for NYSE Stocks. *The Journal of Finance*, 47(2), pp.753-764.

Merton, R.C. (1973). The Theory of Rational Option Pricing. *The Bell Journal of Economics and Management Science*, 4(1), pp.141-183.

Molchanov, A. (2007). Dynamics of Event-Induced Liquidity Changes in the Aftermarket. In: *11th New Zealand Finance Colloquium*. Auckland, New Zealand.

Muscarella, C., Peavy, J. and Vetsuypens, M. (1992). Optimal Exercise of the Over-Allotment Option in IPOs. *Financial Analysts Journal*, 48(3), pp.76-81.

O'Shaughnessy, P. (2019). *Bill Gurley - Direct Listing vs. IPO*. Invest Like the Best.

Quboa, Q., Saadouni, B., Shahgholian, A. and Mehandjiev, N. (2017). Detecting Underwriters Stabilisation Trades: A Clinical Study. *Lecture Notes in Business Information Processing*, pp.32-46.

Ritter, J. (2019). *Initial Public Offerings: Underwriting Statistics Through 2018*. [pdf]. Available at: https://site.warrington.ufl.edu/ritter/files/2019/04/IPOs2018Underwriting-1.pdf [Accessed 28 Oct. 2019].

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

11. Appendix

Table A1: Sample of IPOs

Ticker	Year	Cap	Sector	Underwriters	Lead Underwriter(s)	Issue size (SEK)	Shares issued	IPO price (SEK)	OAO %-age	OAO exercise
AWP	2010	Small	Utilities	3	ABG	590 150 000	10 730 000	55	15%	Full
BMAX	2010	Mid	Retail	2	ABG, Carnegie	1 180 443 413	25 661 813	46	15%	Partial
MQ	2010	Small	Retail	2	SEB	622 779 424	19 461 857	32	15%	Full
KDEV	2011	Mid	Healthcare	5	SEB	456 000 000	11 400 000	40	15%	Full
FBAB	2011	Small	Consumer	3	Carnegie, Handelsbanken, UBS	90 710 123	1 851 227	49	15%	Partial
TRMO	2011	Mid	TMT	4	Carnegie, Handelsbanken, UBS	403 421 372	7 611 724	53	13%	Partial
PLAZ B	2013	Mid	Financial Services	3	Handelsbanken	613 800 000	22 000 000	28	15%	Full
SNTC	2013	Mid	Industrials	4	Nordea, UBS	3 182 608 754	52 173 914	61	15%	None
BUFAB	2014	Mid	Industrials	2	Carnegie, Handelsbanken	1 098 795 790	23 886 865	46	15%	None
HEMF	2014	Mid	Real Estate	2	SEB, Swedbank	6 065 216 960	65 217 387	93	15%	None
RECI B	2014	Mid	Healthcare	3	Carnegie, SEB	1 309 299 810	16 785 895	78	15%	None
COMH	2014	Large	TMT	4	JP Morgan, Morgan Stanley, Nordea	7 473 751 298	128 857 781	58	10%	None
BACTI B	2014	Mid	Healthcare	2	Swedbank	648 100 146	17 055 267	38	10%	Full
SCST	2014	Mid	Consumer	3	Carnegie, Danske Bank	1 378 563 880	34 464 097	40	15%	None
INWI	2014	Mid	Industrials	3	Carnegie, Handelsbanken	2 562 149 424	37 678 668	68	15%	Full
GRNG	2014	Mid	Consumer	4	Carnegie, SEB	2 283 962 750	53 740 300	43	15%	None
LIFCO B	2014	Mid	Industrials	3	SEB	3 832 539 300	41 210 100	93	10%	None
THULE	2014	Mid	Consumer	3	Goldman Sachs, Nordea	1 826 086 990	26 086 957	70	15%	None
NP3	2014	Mid	Financial Services	2	Catella	200 000 010	6 666 667	30	15%	None
ELTEL	2015	Mid	Industrials	4	BNP Paribas, SEB, JPM	2 815 101 740	41 398 555	68	15%	None
DUST	2015	Mid	Retail	4	Carnegie, Nordea	1 711 395 200	34 227 904	50	15%	None
HOFI	2015	Mid	Financial Services	3	Carnegie, Morgan Stanley	2 494 080 678	43 001 391	58	15%	None
TROAX	2015	Mid	Construction	2	Carnegie	707 091 462	10 713 507	66	15%	None
TOBII	2015	Mid	TMT	2	Carnegie	447 525 000	17 901 000	25	15%	None
COLL	2015	Mid	Financial Services	1	SEB	999 999 990	18 181 818	55	10%	None

Ticker	Year	Cap	Sector	Underwriters	Lead Underwriter(s)	Issue size (SEK)	Shares issued	IPO price (SEK)	OAO %-age	OAO exercise
COOR	2015	Mid	Industrials	4	Nordea, UBS	2 217 281 798	58 349 521	38	15%	Full
NDX	2015	Large	Financial Services	4	Morgan Stanley, Carnegie	2 588 353 650	57 518 970	45	10%	Full
ALIG	2015	Mid	Industrials	3	Citi, SEB	2 206 890 000	23 730 000	93	15%	None
PNDX B	2015	Large	Real Estate	3	ABG Sundal Collier	5 530 434 884	52 173 914	106	15%	None
NOBINA	2015	Mid	Industrials	3	Carnegie, Danske Bank	2 101 933 833	61 821 583	34	12%	Full
CAPIO	2015	Large	Healthcare	4	JP Morgan, SEB	2 333 946 634	48 122 611	49	10%	None
CLX	2015	Mid	TMT	2	Carnegie, Handelsbanken	740 196 949	12 545 711	59	15%	None
BRAV	2015	Large	Industrials	3	Deutsche Bank, Morgan Stanley, Nordea	3 466 945 480	86 673 637	40	15%	None
DOM	2015	Large	Consumer	3	Jefferies, Morgan Stanley, SEB	4 692 316 944	97 756 603	48	15%	None
ATT	2015	Large	Healthcare	4	Carnegie, SEB	4 332 000 000	86 640 000	50	10%	None
SHOT	2015	Mid	Travel & Leisure	4	Morgan Stanley, SEB	3 065 757 659	45 757 577	67	15%	Partial
GARO	2016	Mid	Industrial	1	Carnegie	292 000 000	4 000 000	73	15%	None
RESURS	2016	Large	Banks	4	Carnegie, Goldman Sachs, Morgan Stanley	3 571 333 370	64 933 334	55	15%	Partial
NWG	2016	Mid	Construction	2	Carnegie, ABG	1 011 525 340	14 450 362	70	15%	Partial
TFBANK	2016	Mid	Banks	2	Carnegie, ABG	435 939 581	5 661 553	77	15%	Partial
ACAD	2016	Mid	Retail	3	Carnegie	950 000 000	23 750 000	40	15%	None
ENG	2016	Mid	Retail	2	ABG, Handelsbanken	520 650 000	10 012 500	52	15%	None
ATORX	2016	Mid	Healthcare	2	Carnegie	420 000 003	12 923 077	33	15%	Partial
SRNKE B	2016	Mid	Construction	1	Carnegie	636 549 980	5 786 818	110	12%	Full
VOLO	2016	Mid	Industrials	3	Carnegie, Nordea	1 100 000 044	18 965 518	58	10%	None
EDGE	2016	Small	Technology	2	Carnegie	391 922 820	13 514 580	29	15%	Partial
ONCO	2017	Mid	Healthcare	3	ABG Sundal Collier, Carnegie	649 999 964	14 130 434	46	15%	Partial
MIPS	2017	Mid	Consumer	2	ABG Sundal Collier, Handelsbanken	570 371 112	12 399 372	46	15%	None
AMBEA	2017	Mid	Healthcare	3	Carnegie, Nordea	1 992 412 125	26 565 495	75	15%	None
SSM	2017	Small	Real Estate	2	ABG Sundal Collier, SEB	578 975 024	9 813 136	59	15%	Full
ATIC	2017	Small	Travel & Leisure	3	SEB	434 999 930	8 613 860	51	15%	Partial
INSTAL	2017	Mid	Industrials	2	SEB	967 912 605	17 598 411	55	15%	None
MTRS	2017	Large	Industrials	5	Carnegie, Goldman Sachs	4 174 114 175	75 892 985	55	12%	None

Ticker	Year	Cap	Sector	Underwriters	Lead Underwriter(s)	Issue size (SEK)	Shares issued	IPO price (SEK)	OAO %-age	OAO exercise
MCOV B	2017	Mid	Healthcare	4	Jefferies, SEB	2 030 700 000	36 262 500	56	15%	None
BOOZT	2017	Mid	Retail	3	Carnegie, Danske Bank	1 612 967 448	26 015 604	62	15%	None
BONEX	2017	Small	Healthcare	2	ABG Sundal Collier, Carnegie	499 999 991	17 241 379	29	15%	Partial
BALCO	2017	Small	Construction	2	Carnegie	720 006 784	12 857 264	56	15%	None
HANDI	2017	Small	Healthcare	3	BAML, Carnegie	1 059 723 220	17 092 310	62	15%	None
BIOA B	2017	Mid	Healthcare	2	Carnegie	699 999 984	29 166 666	24	15%	None
FNM	2017	Mid	industrials	1	Carnegie	449 673 000	2 997 820	150	15%	None
BHG	2018	Mid	Retail	3	Carnegie	1 408 263 850	29 647 660	48	15%	Full
NCAB	2018	Small	TMT	1	Carnegie	668 701 200	8 916 016	75	15%	Partial
BETCO	2018	Mid	TMT	2	Nordea, SEB	839 415 240	15 544 727	54	15%	None
PENG B	2018	Small	Industrials	1	SEB	470 181 420	10 003 860	47	15%	Partial
CALTX	2018	Mid	Healthcare	3	Carnegie	649 999 800	14 444 440	45	15%	Partial
LIME	2018	Small	TMT	2	Carnegie	318 834 720	4 428 260	72	15%	None
QLINEA	2018	Mid	Healthcare	2	Carnegie	623 333 334	9 166 667	68	15%	Full
ACE	2019	Small	Healthcare	2	Vator Securities	200 000 000	8 000 000	25	15%	Partial
KAR	2019	Mid	Retail	2	Carnegie	2 602 077 633	60 513 433	43	15%	Partial
JOMA	2019	Mid	Real Estate	2	Carnegie, Handelsbanken	1 305 000 000	14 500 000	90	15%	None
K2A B	2019	Mid	Real Estate	2	Carnegie, Swedbank	260 869 620	3 674 220	71	15%	None
8TRA	2019	Large	Industrials	9	Citi, Deutsche Bank, Goldman Sachs, JPM	14 125 000 000	50 000 000	283	15%	Full

Note: The table contains the listings on Nasdaq main markets from January 2919 to July 2019 that are relevant to our study. We obtain company names and listing dates of all public offerings on the Swedish small-, mid- and large cap markets on the Nasdaq website, yielding an initial sample consisting of 135 listings. To make the sample more relevant to our analysis, we exclude all events that did not include an equity offering to the public, including secondary offerings, demergers, list transfers. We also exclude IPOs where there was no inclusion of an overallotment option.

Chart A1: Histograms on the distribution of bid-ask spreads

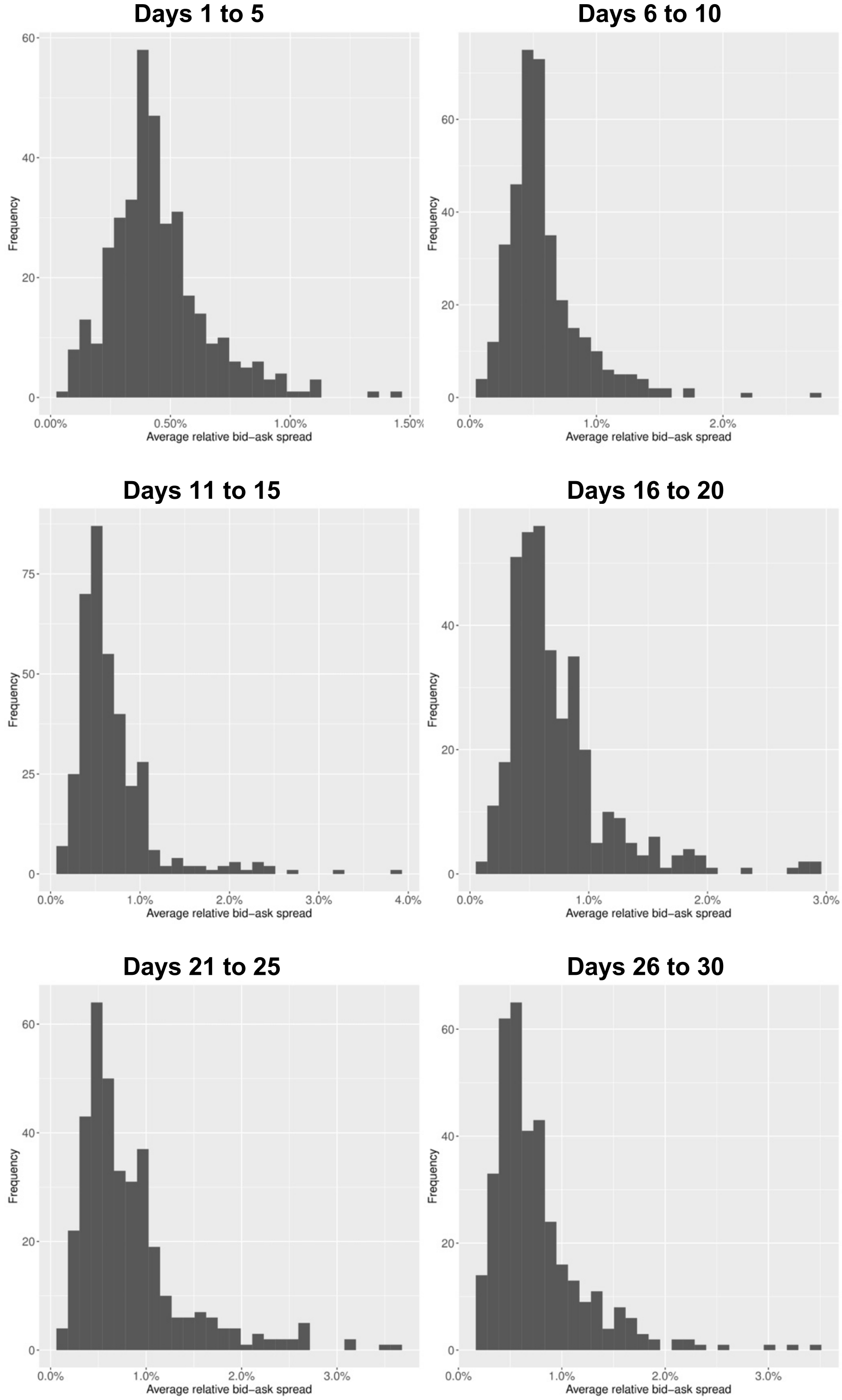


Chart A2: Scatter plots of bid-ask spreads vs. share price development in relation to listing price

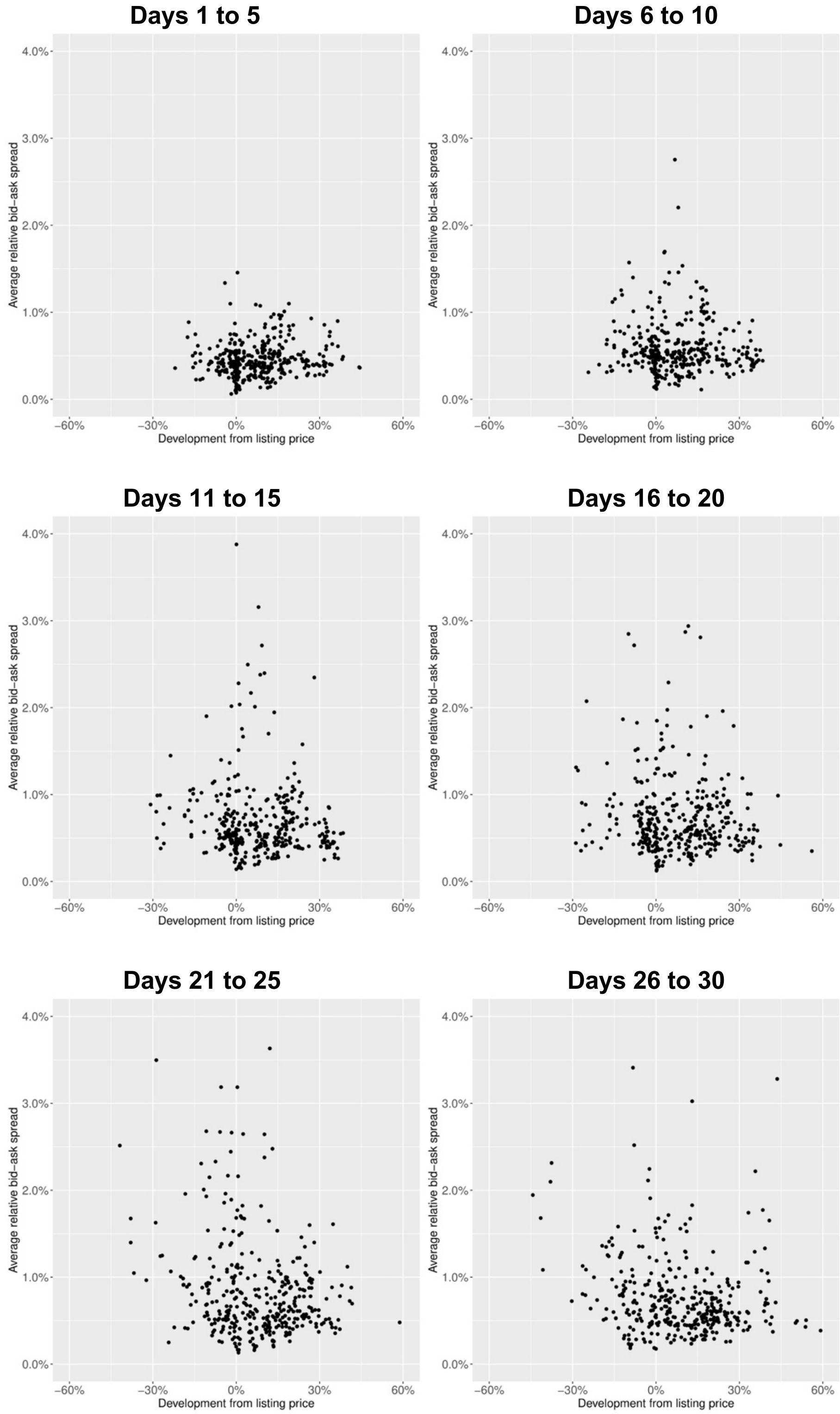


Table A2: Correlation matrix of independent variables

	No. of Underwriters	Price	Volatility	Proxy	Turnover
No. of Underwriters	1.00	0.34	-0.08	-0.11	0.01
Price	0.34	1.00	-0.14	0.22	-0.05
Volatility	-0.08	-0.14	1.00	0.03	0.08
Proxy	-0.11	0.22	0.03	1.00	0.01
Turnover	0.01	-0.05	0.08	0.01	1.00

Note: The table shows the correlation matrix of the independent control variables in the regression models. The correlation matrix is estimated over the first 30 days of trading, including all IPOs in our final sample.

Table A3: Regression results from the full sample

Day	1-5	6-10	11-15	16-20	21-25	26-30
Stabilisation proxy	0.49 **	-0.02	-0.44 **	-0.44 *	-0.30	-0.26
	(0.18)	(0.18)	(0.17)	(0.20)	(0.17)	(0.15)
Volatility	0.18 ***	0.07	0.20 ***	0.16 ***	0.26 ***	0.02
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Turnover	-0.09 ***	-0.06 *	-0.14 ***	-0.10 ***	-0.13 ***	-0.11 ***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
Price	-0.29 ***	-0.13 *	-0.17 *	-0.12	-0.30 ***	-0.30 ***
	(0.06)	(0.06)	(0.07)	(0.07)	(0.08)	(0.05)
No. of underwriters	-0.15 *	-0.39 ***	-0.45 ***	-0.41 ***	-0.40 ***	-0.41 ***
	(0.07)	(0.06)	(0.06)	(0.07)	(0.08)	(0.06)
N	365	365	365	365	365	363
R^2	0.26	0.17	0.31	0.22	0.29	0.27
Adj. R^2	0.25	0.16	0.30	0.21	0.28	0.26
Std. errors	Robust					

*** p < 0.001; ** p < 0.01; * p < 0.05

Note: The table presents a summary of the coefficients of the stabilisation proxy and control variables for the full sample. Note that there are two missing observations in the days 26-30, as there was no trading in two companies during one trading day. P-values are based on two-sided coefficient tests. The model specification for the regressions is:

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Proxy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

Table A4: Regression results from the AFP sample

Model	Floor Price = 0.98P*						Floor Price = 1.00P*					
Day	1-5	6-10	11-15	16-20	21-25	26-30	1-5	6-10	11-15	16-20	21-25	26-30
Stabilisation proxy	0.81 ***	0.22	-0.28	-0.06	-0.09	0.39	0.58 *	0.22	-0.23	-0.03	-0.13	0.29
	(0.23)	(0.23)	(0.26)	(0.27)	(0.26)	(0.25)	(0.23)	(0.27)	(0.29)	(0.31)	(0.28)	(0.25)
Volatility	0.19 ***	0.06	0.24 ***	0.14 **	0.25 ***	-0.02	0.16 ***	0.05	0.22 ***	0.15 *	0.24 ***	0.02
	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.02)	(0.04)	(0.05)	(0.06)	(0.04)	(0.04)
Turnover	-0.10 ***	-0.05	-0.17 ***	-0.12 ***	-0.11 ***	-0.10 ***	-0.09 ***	-0.12 ***	-0.18 ***	-0.13 ***	-0.10 **	-0.12 ***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Price	-0.28 ***	-0.07	-0.07	-0.04	-0.20 *	-0.19 **	-0.24 ***	-0.08	-0.11	-0.05	-0.13	-0.19 *
	(0.07)	(0.07)	(0.07)	(0.08)	(0.09)	(0.07)	(0.07)	(0.08)	(0.08)	(0.09)	(0.11)	(0.08)
No. of underwriters	-0.19 **	-0.46 ***	-0.59 ***	-0.54 ***	-0.51 ***	-0.52 ***	-0.21 **	-0.45 ***	-0.60 ***	-0.55 ***	-0.51 ***	-0.49 ***
	(0.07)	(0.07)	(0.06)	(0.07)	(0.09)	(0.05)	(0.07)	(0.07)	(0.07)	(0.08)	(0.09)	(0.05)
N	304	303	283	274	269	271	253	245	242	244	241	251
R^2	0.34	0.21	0.41	0.29	0.30	0.30	0.30	0.23	0.44	0.29	0.30	0.28
Adj. R^2	0.33	0.20	0.40	0.28	0.29	0.29	0.29	0.22	0.43	0.28	0.28	0.27
Std. errors	Robust						Robust					

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Note: The table presents a summary of the coefficients of the stabilisation proxy and control variables for the above floor price (AFP) sample, depending on the chosen floor price. Note that the number of observations is varying as the number of companies included in the sample changes for every time period depending on their price development. P-values are based on two-sided coefficient tests, using robust standard errors. P* refers to the listing price. The model specification for the regressions is:

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Proxy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

Table A5: Regression results from the BFP sample

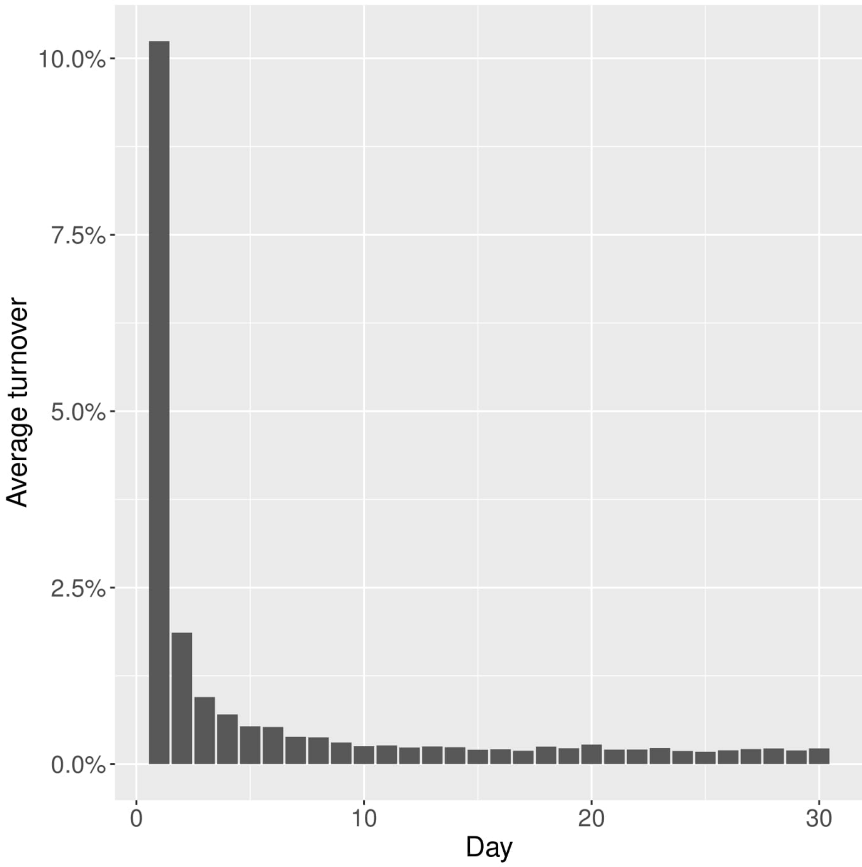
Model	Floor Price = 0.98P*						Floor Price = 1.00P*					
Day	1-5	6-10	11-15	16-20	21-25	26-30	1-5	6-10	11-15	16-20	21-25	26-30
Stabilisation proxy	-1.31	0.65	0.09	0.44	-1.64 *	-1.34 *	-1.16	-1.31	-0.88	-0.46	-1.43 *	-2.29 ***
	(0.99)	(1.54)	(0.61)	(0.73)	(0.64)	(0.53)	(0.89)	(1.01)	(0.50)	(0.60)	(0.59)	(0.47)
Volatility	-0.38 ***	0.01	0.23 **	0.23 ***	-0.08	-0.18 *	0.16 **	0.01	0.14 *	0.20 ***	0.13	-0.15 *
	(0.09)	(0.11)	(0.07)	(0.06)	(0.11)	(0.08)	(0.05)	(0.08)	(0.05)	(0.06)	(0.11)	(0.06)
Turnover	-0.00	-0.19 *	-0.09 *	-0.08 *	-0.24 ***	-0.16 ***	-0.06	0.04	-0.05	-0.06	-0.19 ***	-0.12 ***
	(0.03)	(0.08)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Price	-0.18	-0.19	-0.24	-0.30 *	-0.58 ***	-0.70 ***	-0.45 **	-0.29 ***	-0.18	-0.19 *	-0.60 ***	-0.52 ***
	(0.09)	(0.12)	(0.14)	(0.15)	(0.08)	(0.08)	(0.15)	(0.08)	(0.10)	(0.08)	(0.07)	(0.07)
No. of underwriters	-0.10	-0.08	0.14	0.01	0.13	0.07	-0.02	-0.21 *	-0.02	-0.03	-0.01	-0.10
	(0.16)	(0.09)	(0.13)	(0.15)	(0.11)	(0.10)	(0.14)	(0.09)	(0.11)	(0.10)	(0.11)	(0.10)
N	61	62	82	91	96	92	112	120	123	121	124	112
R^2	0.29	0.14	0.18	0.21	0.38	0.47	0.24	0.20	0.13	0.19	0.34	0.42
Adj. R^2	0.23	0.07	0.12	0.17	0.34	0.44	0.20	0.16	0.09	0.15	0.32	0.39
Std. errors	Robust						Robust					

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Note: The table presents a summary of the coefficients of the stabilisation proxy and control variables for the below floor price (BFP) sample, depending on the chosen floor price. Note that the number of observations is varying as the number of companies included in the sample changes for every time period depending on their price development. P-values are based on two-sided coefficient tests, using robust standard errors. P* refers to the listing price. The model specification for the regressions is:

$$ln(RBAS_{i,t}) = \beta_0 + \beta_1 Proxy_{i,t} + \beta_2 ln(Turnover_{i,t}) + \beta_3\, ln(Price_{i,t}) + \beta_4 \ln(Volatility_i) + \beta_5 ln(Underwriters_i)$$

Chart A3: Average daily turnover



Note: The chart shows the average daily turnover for the companies in our sample during the initial 30 days of trading. Turnover is defined as the total traded volume divided by the total size of the offering.