# OVER-ALLOTMENT OPTIONS IN IPOS ON GERMANY'S NEUER MARKT
## - AN EMPIRICAL INVESTIGATION -

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Over-allotment arrangements are nowadays part of almost any initial public offering. The underwriting banks borrow stocks from the previous shareholders to issue more than the initially announced number of shares. This is combined with the option to cover this short position at the issue price. We present empirical evidence on the value of these arrangements to the underwriters of initial public offerings on the Neuer Markt. The over-allotment arrangement is regarded as a portfolio of a long call option and a short position in a forward contract on the stock, which is different from other approaches presented in the literature.

Given the economically substantial values for these option-like claims we try to identify benefits to previous shareholders or new investors when the company is using this instrument in the process of going public. Although we carefully control for potential endogeneity problems, we find virtually no evidence for a reduction in underpricing for firms using over-allotment arrangements. Furthermore, we do not find evidence for more pronounced price stabilization activities or better aftermarket performance for firms granting an over-allotment arrangement to the underwriting banks.

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# 1. Introduction and Motivation

Since the mid nineties book building has increasingly replaced the fixed-price method as the standard procedure for setting the issue price in initial public offerings (IPOs) in Germany. Along with this change the instrument of the over-allotment option (also called "greenshoe" option[1]) has gained considerable importance. An over-allotment arrangement (OAA) typically works as follows. To be able to meet potentially higher demand for an issue, i.e. to be able to place more than the initially announced number of shares, the underwriter borrows additional shares (the greenshoe (GS))[2] from the company going public. This borrowing of the shares comes with the obligation for the underwriter to return the shares within a fixed period of time, usually one month. In case of a bullish market the underwriter might thus be forced to buy back the shares at a higher price, thereby incurring a loss. An OAA, including a GS option, however, allows the underwriting bank to buy the shares from the issuing firm at the issue price, and this agreement protects the underwriter against unfavorable price movements in the secondary market. On the other hand, a trading profit for the underwriting bank could arise if the stock trades below the issuing price sometime during the life of the OAA, since the underwriter could then buy the shares on the market and return them to the lenders to cover the short position with a profit equal to the difference between the issuing price and the lower market price. So the total position of the underwriter in an OAA consists of a short position in a forward contract on the stock plus a call option or, alternatively, of a put option and some constant payment. It should be noted here that this

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[1] The option is named after the first initial public offering (IPO) where such an over-allotment arrangement was implemented. This was in 1924 when Greenshoe Manufactoring Co. went public.

[2] For a better understanding we will differentiate between the phrase "over-allotment arrangement" (OAA) for the arrangement in total and use the term greenshoe (GS) when talking about the additional shares to be issued at the IPO.

view of an OAA differs from what is usually found in the literature, since in most papers[3] only one component of the portfolio, namely the call option, is considered explicitly. For valuation purposes this would be correct as long as one could safely assume the value of the short position to be equal to zero. However, as we will show below, this is only justified in the case of (almost) zero underpricing, which is certainly not representative for the majority of IPOs.

OAAs have been heavily used in IPOs on a segment of the German market called "Neuer Markt" which can best be compared to the NASDAQ in the U.S., since it represented the primary market segment for high-growth stocks in Germany from 1997 to 2002.[4] The fact that in the late stage of the Neuer Markt there was not a single IPO without an OAA raises the question why this instrument has become so popular in Germany. In the literature it is often argued that the existence of such a contract is in the best interest of the issuer, the underwriting bank, and the IPO investor.[5] However, some sources also emphasize that underwriting banks tend to use the OAA merely in line with their self-interest, which does not necessarily match with the interests of the issuers and the investors.[6] Given these controversial opinions it becomes important to briefly discuss who would actually suffer wealth losses when OAAs are given to the underwriting banks for free, i.e. without an explicit payment from the underwriter, which seemed to be common practice in IPOs on the Neuer Markt. Here we have

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[3] See for instance Hansen, Fuller and Jangjigian (1987) and Muscarella, Peavy and Vetsuypens (1992).

[4] In late September 2002 the Deutsche Börse AG announced that the Neuer Markt segment would be closed by the end of 2002. However, it was also announced that a new index (TecDAX) should be introduced in 2003. This index is supposed to represent a market segment similar to the former Neuer Markt.

[5] See for instance Prabhala and Puri (1998) and Benviste, Erdal, and Wilhelm (1998).

[6] Taranto (2000) takes the view that at the IPO investment banks have market power and behave according to their profit maximization calculus, i.e. they maximize the total profit resulting from the gross spread, the OAA and other sources, including aftermarket trading.

to distinguish between two possible sources for the shares included in the OAA.[7] First, these shares might come from previous shareholders. In this case the previous shareholders receive back their shares exactly when they would have been better off with a definite placement at the issue date, since then they would have received the issue price, whereas now they hold the shares which are worth less than the issue price and which are moreover locked up, i.e. cannot be sold, for at least another six months. In case the company uses a seasoned equity offering to increase its equity capital for the OAA, the shares would be returned to the firm again in the situation when they are worth less than the issue price. The firm would thus have to buy back its own shares at a price above market value. Rational investors would take this into account by reducing the price they would be willing to pay for the issue by exactly the value of the OAA (see also Benviste, Erdal and Wilhelm (1998)). This would again hurt the former shareholders, so that we can conclude that it is always them who would have to receive a compensation for an OAA in one way or another. Thus, the empirical task is to investigate whether there are actual benefits for the group of former shareholders granting these rights to the underwriting banks, and whether these benefits are sufficiently high to represent an adequate compensation for the overall value of the arrangement.

This paper is not the first to analyze OAAs. Still, within the vast literature on IPOs, this topic has received surprisingly little attention. Reasons for this might be that the value of the OAA is merely considered as another form of payment to the underwriter and that the total compensation paid to the underwriter is assumed to basically remain unchanged, irrespective of the existence of such a contract. The hypothesis would thus be that the underwriter and the former owners of the shares would only agree on a specific way to

[7] In our analysis we neglect the special case of a so-called deferred settlement. The content of such a deferred settlement with institutional investors is that they receive their shares not immediately at the issue date but a few weeks later. For more details see, e.g., Schanz (2002).

decompose the total compensation into explicit fees and an implicit payment in the form of a free OAA. Alternatively, one could take the view that the economic value of the contract is just a fair payment to the underwriter for its services, such as price stabilization in the aftermarket.[8, 9] Finally, it could be the case that the value of an OAA tends to be too small to be of economic importance.

The issue of who receives the benefits from an OAA is tackled by Aggarwal (2001), who argues that price support can be beneficial by alleviating sales pressure generated by so-called flippers, i.e. investors who re-sell the stocks they obtained in the IPO after a very short holding period. According to Benviste, Erdal, and Wilhelm (1998) institutional investors are the primary beneficiaries of price stabilization efforts, since they are able to limit their exposure and liquidate large quantities at minimal risk after they have learned that an issue has been poorly received. However, the mechanism of price support should only work in imperfect markets, since according to theory in perfectly liquid markets, the buying and selling of stocks should not have any impact on prices.

In a study on seasoned equity offerings Hansen, Fuller, and Janjigian (1987) explain that price support and thus better underwriter risk management[10] at the time of the offering are not the only arguments for the use of an OAA. Underwriters often oversell at the offering in expectation of reneging investors who had initially expressed interest in subscribing some

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[8] Jenkinson and Ljungqvist (2001) mention that the most common price support activities, which range from activities that stimulate demand to activities that restrict supply, are the posting of limit orders at the offer price and the buy backs of shares.

[9] Such price stabilization activities can generally only be detected by market regulators. As an inferior alternative empirical approach aftermarket microstructure data can be analyzed, such as underwriters' market-making activities or short-covering transactions. The aspect of price stabilization activities in the IPO aftermarket is the focus of recent studies for instance those by Benviste, Erdal, and Wilhelm (1998), Prabhala and Puri (1999), Ellis, Michaely, and O'Hara (2000), and by Aggarwal (2000).

[10] Underwriters should be concerned about large price drops, since this could lead to a loss of reputation.

shares. In case the actual level of reneging is less than expected, the OAA protects underwriters against losses from short covering in the aftermarket with upward price movements. However, in bullish markets, when short covering losses should be most serious, allocations are usually rationed and thus renegotiations should be rare (see, e.g., Muscarella, Peavy, and Vetsuypens (1992)).

Another non-price stabilization benefit, though not for the group granting the OAA, is mentioned by Carter and Dark (1990). It concerns the underwriting banks' ability to allocate an extra fraction of particularly attractive and oversubscribed shares to special clients, which allows them to build client relationships and to enhance reputation.

Work investigating the valuation of OAAs includes the papers by Hansen, Fuller, and Janjigian (1987), and by Taranto (2000). The approach taken by Hansen, Fuller, and Janjigian (1987) differs from ours with regard to the modeling of the claim, since they suggest that the OAA should simply be treated as a call option. They neglect that the OAA consists of two components, as described above. Taranto (2000) on the other hand, who models the OAA similar to our approach, avoids to draw any conclusions from the modeling of the claim with regard to the underwriter's strategy for setting the issue price.

Other aspects of OAAs are treated, e.g., in Hansen, Fuller, and Janjigian (1987) who find that OAAs are used in particular by riskier firms, i.e. by firms which are characterized by greater share volatility. Carter and Dark (1990) focus on the size of the GS in IPOs. Their results indicate similar to those of Hansen, Fuller, and Janjigian (1987) that the size of the GS increases with the risk of the issuing company. Muscarella, Peavy, and Vetsuypens (1992) compare offerings of stocks to offerings of closed-end funds with respect to whether a GS option has actually been exercised. They find that the amount of underpricing of an issue and the aftermarket price performance are key variables influencing the probability of exercise. This is also confirmed by Cotter and Thomas (1998) who discuss this instrument from a more

legal perspective, asking whether a tighter regulation for the underwriters' use of the OAA is necessary[11].

In this paper we first perform a valuation of OAAs and then analyze the relationship of this value to other payments made by the issuing company to the underwriting bank. We investigate whether issues with OAAs perform better than IPOs without this feature. Here the term 'performance' should be seen in a more general context, including aspects like a lower underpricing and a general reduction in fees charged by the underwriter. When analyzing the amount of underpricing in more detail we assume that the issuer tries to minimize his overall wealth loss in the process of going public, which is in line with the approach developed by Habib and Ljungqvist (1998). We test our hypothesis that issues with OAA exhibit lower underpricing by means of a regression analysis, taking into account that different parts of the costs of going public are endogenous to underpricing. The empirical analysis is based on a data set of firms having gone public at Neuer Markt from March 1997 to December 2001. As we will show the value of the typical OAA is economically non-negligible, so that it potentially constitutes a significant extra compensation for the banks involved in the IPO. This result makes it necessary to take a closer look at potential differences between the companies granting such an option and those not granting it. We discuss along the lines of Hansen, Fuller, and Janjigian (1987) whether issuers receive indirect compensation for the OAA, e.g. through a reduction in underwriting fees or through a lower underpricing. One might think of other parties benefiting as well, for example IPO investors who might be better

[11] In the US the National Association of Securities Dealers (NASD) has restricted the over-allotment option to 15% (10% prior to August 1983). Although the offering prospectus has to reveal the existence of an OAA and the possibility of price support in the aftermarket, there is no requirement that forces the underwriter to disclose how many shares are actually sold at the IPO date. Cotter and Thomas (1998, p. 264) recommend such a disclosure in order to "better inform the markets and investors about how underwriters are using the OAA and price stabilization activities to make money for themselves."

off due to a better return performance in the secondary market. Our main findings in this section indicate that there is at least no strong evidence in favor of indirect benefits for previous shareholders. The underpricing of issues with and without OAAs is virtually indistinguishable, and although a small reduction in underwriting fees can be observed it is far from being comparable to the estimated option value. Using a simple proxy measure for the effect of price stabilization we find no significant differences between issues with and without an OAA. The same holds true for the difference between the two groups in the average market-adjusted return over the first 21 trading days after the issue date.

The remainder of the paper is structured as follows. In section 2 we will explain the basic mechanism of the OAA in more detail, before we formally derive a theoretical upper bound for its value in a contingent claims framework. In section 3 we describe our data set. Section 4 contains the results of our empirical analysis. The paper concludes with a summary in section 5.

## 2. The Value of the Over-Allotment Arrangement

As described above, an OAA consists of a short position in the stock for the underwriter, combined with the right to purchase the stock at the issuing price from the previous shareholders. If the shares remain ultimately issued after the OAA period, i.e. if they are not physically returned to the previous shareholders, the underwriter receives the gross spread which has been set in the bilateral IPO contract. With $T$ as the end of the option period, $S_T$ as the stock price at time $T$, $f$ as the gross spread, and $E$ as the issue price, the terminal payoff $g_T$ to the underwriter is thus given by

$$g_T = \max(E - S_T, fE).$$

To see this, consider first the case of a strong upward movement of the stock over the OAA period. In order to cover the short position the call option will be exercised, i.e. the underwriter 'buys' the shares from the previous shareholders at a price of $E$ and does not return them physically. Moreover, the bank receives the negotiated gross spread $fE$. On the other hand, if the stock price has fallen sufficiently, it will be favorable for the underwriter to buy back the shares on the secondary market, yielding a trading profit of $E - S_T$. It is important to note that the underwriter will not automatically buy back the shares on the market, if the terminal stock price is less than $E$, since this would mean not to receive the gross spread $fE$. There is a range of prices below $E$ where the underwriter still prefers to receive the spread rather than the trading profit.[12]

It is commonly assumed in the literature[13] that the claim $g$ is European, although basically early exercise is permitted, since the underwriter could buy back the shares on the market at any time over the OAA period and return them to the previous shareholders. However, since the time to maturity of the option is usually rather short, and since the associated put (see below) is out of the money in case of underpricing, the additional value created by the early exercise premium will generally be negligible. This means that the claim can be valued as if it was European. As an immediate consequence we can decompose the terminal payoff $g_T$ according to

$$\begin{aligned} g_T &= \max(E - S_T, fE) \\ &= \max((1-f)E - S_T, 0) + fE \end{aligned}$$

[12] As Muscarella, Peavy and Vetsuypens (1992) point out, underwriters are in a "no-lose" position with respect to over-allotting activities and should accordingly always try to overallocate IPOs with an OAA.

[13] See, e.g., Taranto (2000).

So the payoff to the underwriter can be represented by a European put on $S$ with strike price $(1-f)E$, plus a deterministic payment equal to the gross spread $fE$. Using put-call parity we can again rewrite this as

$$\begin{aligned} g_T &= \max((1-f)E - S_T, 0) + fE \\ &= \max(S_T - (1-f)E, 0) - S_T + (1-f)E + fE \\ &= \max(S_T - (1-f)E, 0) - S_T + E, \end{aligned}$$

i.e. the payoff is equal to the payoff of a long call, again with strike price $(1-f)E$ plus the payoff of short forward with forward price $E$. At this point in our analysis the difference to Hansen, Fuller, and Janjigian (1987) becomes obvious, who only consider the value of the call in their analysis of OAAs. The value of the forward short is only zero, however, when the forward price is given by the initial stock price, compounded at the risk-free rate, i.e. $E = S_0 \exp(rT)$. Even if we set the interest rate equal to zero for simplicity, the present value of a payment of $E$-$S_T$ will not be equal to zero if the initial stock price $S_0$ is not close to the issue price $E$. In a situation of pronounced underpricing, $S_0$ will be much greater than $E$, yielding a substantially negative value for the short position in the forward.

The valuation of an OAA along these lines is of course based on some simplifying assumptions. One is that the underwriter does not (or does not have to) perform price stabilization in the aftermarket. If price stabilization is performed, and the underwriter would have to buy shares on the market as soon as the stock price falls below a certain critical level, the OAA would obviously lose value. In the extreme case of an (underpriced) issue with price support exactly at the issuing price $E$, the claim $g$ would have the deterministic payoff $fE$, i.e. the bank would always receive the gross spread on the additional shares, assuming that the market price of the shares could actually be stabilized at or above $E$.

Moreover we suppose that only at the time of the IPO the underwriting bank is

allowed to allot the additional shares at the issuing price.[14, 15] As we will see this is an essential condition in order to give the underwriting bank an incentive to set the issuing price close to the (expected) first market price.

According to the argument put forward by Hansen, Fuller, and Janjigian (1987) treating the OAA as a call option only underwriters would have an incentive to excessively underprice the issue, since the call becomes more valuable with an increasing difference between the current stock price and the strike price, which equals the issuing price. So considering also the short forward is essential not only with regard to the value of the OAA but also with regard to the underwriter's pricing calculus. Taranto (2000) models the value of the OAA for the special case of an underwriting bank which simultaneously acts as a market maker in the newly issued stock. He computes the value of an OAA in a way similar to ours, but he avoids to draw any conclusions from the modeling of the claim with regard to the underwriter's strategy for setting the issue price.

It is well known that the value of a put increases the higher the volatility of the underlying stock and the smaller the initial stock price relative to the strike price. Thus, in our case the underwriter will have an incentive to reduce the amount of underpricing when maximizing the value of the claim. However, for several reasons the underwriter will also be cautious not to overprice. As a consequence of overpricing the underwriter, who is a repeat player in the IPO business, will lose reputation from the point of view of potential investors in IPO shares. Moreover, according to theory (see Rock (1986)) the demand for potentially overpriced shares should be low, since informed investors would not subscribe to such issues

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[14] Alternatively the underwriting bank could sell only the original volume at the IPO and could try to allot the volume of the over-allotment on the secondary market at a higher share price.

[15] According to Schanz (2002) there have been no legal proceedings yet to clarify whether the underwriter is obliged to actually *issue* the additional shares in the GS, instead of selling them on the secondary market.

at all. The OAA, however, only becomes valuable when the GS can actually be sold at the issue date. Otherwise the contract has zero value from the start. To sum up, the existence of an OAA should not wipe out but reduce the underwriting banks' incentive to underprice the issue.

In our empirical analysis we will determine the present value of the above payoff using the Black-Scholes formula for a time to maturity of one month. There are two key inputs to this valuation procedure. The first is the initial stock price, which in our case is taken to be the midpoint of the pre-IPO quotes from the last trading day before the issue date. This midpoint quote provides a better approximation to the fair value of the stock before the IPO actually took place than the issuing price.[16] The quotes were provided by the brokerage firm *Schnigge* and are available for 256 out of the 269 stocks with an OAA in our sample. This means a significant improvement in data quality, since usually pre-IPO prices were hardly available for the German market. The less preferable alternative would be to take the price at the end of the first trading day as it is done, for example, by Taranto (2000). The second central piece of data for the valuation of a contingent claim is the volatility of the underlying asset. Although a set of pre-IPO prices is available for a large fraction of the issues in our sample, these time series are in general too short to be useful for a meaningful volatility estimation. We therefore have to use prices from the secondary market to estimate pre-IPO volatility. To minimize estimation problems, which might arise from price stabilization during the life of the OAA, we avoid using data from this period in the estimation process. Instead, we take the 20 daily returns immediately following the first 21 trading days to compute a

[16] A recent study by Löffler, Panther and Theissen (2002) finds pre-issue prices to be highly informative and largely unbiased estimates of the subsequent exchange prices.

return standard deviation outside the OAA window, which is then annualized and used as input in our valuation procedure.

Although the value of this claim is interesting per se, the key output of this valuation exercise is the additional value (beyond the gross spread) that is generated for the underwriter through the OAA. It is this part of the value that would have to be compensated by additional benefits for other parties involved in the issue or the amount by which other types of the underwriters' compensation would have to be reduced to keep total compensation constant.

## 3. Data and Descriptive Statistics

In total our data set contains 352 IPOs. Each of these companies was listed for the first time during the period of March 10, 1997 to December 31, 2001 on the Neuer Markt. The final sample consisting of 300 IPOs does not contain those 28 companies that merely changed the market segment or had already been listed at a foreign stock exchange before going public at Neuer Markt. In addition, four companies from the financial services industry were excluded due to extraordinarily high values for the book value of assets or the total volume of issues. Finally, another 20 companies could not be taken into consideration, since either the amount of the underwriting fee or the total flotation costs were not available.

Detailed information on the issues was collected from the prospectus. We recorded the number of shares in the GS, the total volume of the issue, the issuing procedure, the offering expenses including the underwriting fee and the total flotation costs, the age of the company, the number of employees and data from the financial statements. Additionally, we recorded the closing stock price on the first day of trading, the book-building range, the closing bid price for the first 30 trading days after the IPO as well as information on whether the underwriter had exercised the OAA (and if so, to what extent).

Before we discuss data directly related to the OAA we want to give a brief general overview of our sample. As shown in table 1 the number of IPO-firms in our sample exhibits a peak in the year 2000 with 124 issues, followed by a sharp decrease in 2001. This reflects (among other things) the rapid decline in stock prices for growth companies, which was also experienced on NASDAQ in the U.S., as well as the general downturn in the economy. The average issue size kept increasing until the year 2000 where it reached a value of roughly € 102 million (about four times the size of the average IPO in 1997), and then again decreased in 2001. While Chen and Ritter (2000) report gross spreads in the US clustering at 7% we do not find such a phenomenon in Germany. At Neuer Markt the average gross spread[17] ranges from 4.72% in 1997 to 5.46% in 2001 with a mean over the whole sample of 5.27%. Interestingly, the standard deviation of 1.21% is similar to the one observed in the US.[18] The underpricing on Neuer Markt is frequent and quite substantial. 235 out of 300 issues in our sample are underpriced. Over the complete sample the average underpricing amounts to almost 50%, i.e. the price on the first trading day in the secondary market is on average 50% above the issue price. This statistic does not seem to be influenced by a few outliers, since in the two years with the highest IPO activity (1999 and 2000) we observe a mean underpricing that is only slightly lower, with about 44% and 47%, respectively.

The use of OAAs in IPOs has become increasingly popular over our sample period. While in 1997 only 62.50% of the issuing companies granted the underwriting bank such an option, the portion increased monotonically until 2001 when all of the ten issues recorded in

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[17] To determine the gross spread we use the percentage fee charged by the underwriter for the complete issue, i.e. including potential over-allotment. The alternative would be to use just the gross spread set for the initial size of the issue. The differences between these two numbers are small, however, so that they do not have a material impact on the results.

[18] Barondes, Butler, and Sanger (2000) report an average gross spread of 7.36% and a standard deviation of 1.12% for a US sample of IPOs covering the period 1985 through 1998.

this year exhibited this feature. On average about 90% of the issues in our total sample contained an OAA. In about 65% of the issues pre-IPO shareholders provided the shares for the GS, in the remaining cases the necessary additional equity stemmed from approved capital and was raised through a seasoned offering after the option period.

The GS as a percentage of the initial issue size ranges from 4.10% to 33.33%, with an average of 12.72%, a median of 12.37%, and a mode of 15%. As can be seen in table 1 the relative size of GS does not vary substantially over the years, except for a rather high average in 1997, although this estimate is based on five issues only. Since the GS is in most cases good for 15% of the initial issue size, the total value of the OAA can represent a considerable extra value for the underwriter. In 201 out of the 269 cases with an OAA, in 74.72%, the GS was ultimately placed in the market. The fact that the share of exercised GS options decreases over our sample period (from 100% in 1997 to 40% in 2001) can be mainly attributed to the weaker performance of the Neuer Markt towards the end of the observation period.

## 4. Empirical Analysis of Over-Allotment Agreements

In this section we will first present the results of the OAA valuation. As described above we can use the midpoint of pre-IPO quotes from *Schnigge* as a proxy for the initial stock price for the majority of firms in our sample. To highlight the impact of the amount of underpricing on the value of the OAA, we also computed the value using the issuing price as proxy for the stock price at the beginning of the option period.

The first striking result in table 2 is the overall level of volatility measured for the stocks in our sample. As indicated by the median, 50% of the firms exhibit an annualized volatility of 71.9% or more. This extraordinarily high value shows that the stocks in the Neuer Markt indeed represented investments with a considerable amount of risk. Not surprisingly,

these high levels of volatility have a strong impact on option values. The mean (median) of the extra value over the gross spread is 2.99% (1.5%) per share. So with an average gross spread of 5.27% the underwriter receives on average more than half of the spread as additional compensation for taking the firm public. For the upper deciles of issues this additional economic value is even 8.24% or more. When using the issuing price as proxy for the stock price at the beginning of the option period, the OAAs in our sample seem even more valuable with a mean value of 6.33% per share, which is more than the average gross spread.

We would like to emphasize once more that these values represent upper bounds for the potential net wealth transfer from the issuing firm to the underwriter, but the picture is nevertheless quite clear. Having shown that there is significant economic value in an OAA, we now have to investigate if this additional value corresponds to potential benefits for the issuing company or potential investors.

A first step in this analysis is to look at differences between issues with and without an OAA. We can see from table 3 that when larger companies go public they are more likely to grant an OAA to the underwriter. The mean and median book value of assets are roughly 50% larger for an issue with OAA than for the typical firm going public without an OAA, and the difference in medians is highly significant. Another variable related to size is the issue volume in shares. Here the median issue with an OAA is twice as large as one without an OAA, and again the difference is statistically significant. Moreover, issuing companies with an OAA seem to be riskier than those without an OAA, since the annualized volatility of returns from day 1 to 21 in the aftermarket is significantly higher, which is in line with the findings by Hansen, Fuller, and Janjigian (1987) for SEOs. Apart from these three variables, however, we cannot find statistical evidence for the hypothesis that issues with OAA should be significantly different from other IPOs. The median firm in both categories goes public

with an issuing price that is at the upper end of the book building range.[19] Taking a look at the costs associated with going public we find that neither the total flotation costs nor the gross spread are statistically different between the two groups. Again, these results are in line with Hansen, Fuller, and Janjigian (1987), and with Carter and Dark (1990), who find the percentage of the underwriter spread to be independent of the value and size of the OAA. Concerning the underpricing of issues with and without OAAs we expect IPOs with an OAA to be relatively less underpriced. We indeed observe that the mean and median first day return is higher for issues without an OAA. However, this difference is not significant at conventional levels.

In analyzing the amount of underpricing of issues with and without OAA in more depth we follow the conceptual framework developed by Habib and Ljungqvist (1998). They model underpricing as endogenous to the problem of wealth loss minimization encountered in an IPO. In their analysis the total wealth loss per share is a function of the non-underwriting costs[20], the underwriting fee and the wealth losses that accrue from underpricing and dilution. As the authors demonstrate, the incentive to reduce underpricing depends in particular on the participation of the issuing company in the IPO, i.e. on the fraction of shares former shareholders sell in the offering. We extend this framework by including the value of the OAA as a further factor to be considered and assume that former shareholders are able to take influence on the amount of underpricing by spending more on non-underwriting expenses and/or by granting an OAA to the underwriter.[21] By spending more on non-underwriting

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[19] Following Ljungqvist and Jenkinson (2000), the reluctance to price outside the range is distinct in Germany compared to international practice.

[20] The non-underwriting costs cover direct costs like auditing and consulting fees, marketing costs, fees raised by the exchange for the admission to the trading segment and costs for the filing of the prospectus.

[21] In line with Ljungqvist (1999) we assume underwriter fees to be non-discretionary and thus to have no influence on the amount of underpricing.

expenses the issuing company reduces information asymmetries between itself and the group of interested investors which is likely to reduce underpricing. By granting an OAA to the underwriter, the issuing company encourages the underwriting bank to set the issuing price close to the (first) market price, since this will increase the value of the OAA as shown above. So in both cases the issuing company faces a trade-off between investing in costly actions to reduce underpricing and tolerating higher underpricing. In what follows we analyze the hypothesis that companies which went public at Neuer Markt and granted an OAA to the underwriting bank suffered less from underpricing. We explicitly take into account that the value of the OAA (*OAA*) (normalized by the issue's gross proceeds) and the amount of non-underwriting expenses (*exp)* (normalized by the issuing volume) are endogenous to underpricing (*underpr*) by applying a two-stage least squares approach[22]. Using this technique solves the problem of endogeneity by employing instrumental variables which in our case should be correlated with *OAA* and *exp*, respectively, but not with *underpr*. In the regression equation for *OAA* we use the Euribor rate (*euribor*) and the annualized volatility of the 20 daily returns immediately following the first 21 trading days (*volatility1*) as instrumental variables on the right hand side. For *exp* we use the log of the issuing volume (*ln_volume*). Moreover, in line with Habib and Ljungqvist (1998) we control for the participation ratio ($n_{0,s}$)[23], that is the fraction of shares former shareholders sell in the offering. This leads to the following regressions:

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[22] This estimation method solves the problem of the ordinary least square approach that "least square estimates are inconsistent estimates of a structural equation precisely because they are consistent estimates of a mixture of all the equations in the model included" (see Green (1997), p. 736).

[23] The participation ratio ($n_{0,s}$) is no instrumental variable estimator of *exp* since it appears also in the underpricing regression, as will be discussed below.

$$OAA = \alpha_0 + \alpha_1\, volatility1 + \alpha_2\, euribor + \alpha_3\, underpr + e_1$$

$$exp = \beta_0 + \beta_1\, n_{0,s} + \beta_2\, ln\_volume + \beta_3\, underpr + e_2$$

When analyzing underpricing we expect the degree of uncertainty concerning the value of the company to be reflected in the annualized volatility of the 20 daily returns from day 1 to 21 (*volatility2*). There should be a positive relation between uncertainty and underpricing. Since this proxy might be distorted due to underwriter price support (see Ljungqvist (1997)), the log of the number of employees (*empl*) is included, as well. Large companies that go public should be underpriced less than small companies. Furthermore we calculate to what extent the book-building range (*bookb*) was exhausted, since issues exhausting 100% of the book-building range, should exhibit a higher underpricing than IPOs that are priced within the book-building range or even below the minimum price. In addition we use the market trend (*NEMAX*), which is computed as the return of the Nemax All Share index forty days prior to the IPO, expecting a positive sign. The underpricing equation is thus given by:

$$Underpr = \gamma_0 + \gamma_1\, n_{0,s} + \gamma_2\, volatility2 + \gamma_3\, empl + \gamma_4\, bookb + \gamma_5\, NEMAX + \gamma_6\, exp + \gamma_7\, OAA + e_3$$

The estimation results for our system of three equations are presented in table 4. As predicted we indeed find the volatility immediately following the first 21 trading days (*volatility1*) to have a positive and highly significant influence on the value of the OAA. Moreover, having used *Schnigge*-data for the calculation of the value of the OAA, underpricing (*underpr*) turns out to have a negative and highly significant coefficient. It is obvious that the higher the underpricing, the lower the possibility that the call option finishes in the money. With regard to the regression for non-underwriting expenses (*exp)*, we see that

on average there seem to be economies of scale. The higher the issuing volume (*ln_volume*) the lower the amount of non-underwriting expenses per unit of issuing proceeds.

Our estimates for the underpricing regression do not provide any evidence that the granting of a (valuable) OAA to the underwriting bank or the extensive spending of non-underwriting expenses (*exp)* prior to the IPO reduces the amount of underpricing.[24] The coefficients for *OAA* and *exp* have the wrong sign, but lack any statistical significance. Moreover, our findings do not support the hypotheses of Ljungqvist and Habib (1998) that former shareholders selling a large fraction of their pre-IPO assets do particularly care for the pricing of the IPO company. The coefficient for $n_{0,s}$ is negative, but not significant. However, we find a significant reduction in underpricing the larger and more transparent the issuing company (with coefficients for *empl* and *volatility2* of -0.077 and 0.245, respectively), and the less the book-building range was exhausted (with a coefficient of 0.239 for *bookb*). This is in line with earlier studies on the German market.[25] Moreover, the highly significant coefficient for the market trend (*NEMAX*) supports the findings by Löffler (2000) and Franzke (2001) in that underpricing is increasing with the performance of the NEMAX index forty days prior to the IPO.

From the analysis up to now we can deduce that the benefits for the group of persons granting the OAA at least do not seem to come in the form of savings on the gross spread, or on the total flotation costs (as discussed in the section presenting the descriptive results), nor through a reduction in underpricing, which would increase the amount of money received by pre-IPO shareholders selling at the IPO.

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[24] This holds true, whether we use the values of the OAA calculated with *Schnigge*-data or the ones calculated with issuing prices. Compare columns (1) and (4) in table 4.

[25] See for instance Ljungqvist (1997).

The remaining factors to be investigated are an increase in utility for IPO investors through price stabilization or a generally better price performance in the aftermarket. As described above in section 2 the underwriter may act as a market maker for the new issue thereby providing a stabilization service. While it is hard to make a precise statement about stabilizing activities by market makers based on our data, an indirect measure can be designed by looking at the relative frequency with which the price in the aftermarket falls below the issuing price or some other pre-defined critical level. Of course this probability is directly related to the volatility of the stock, with more volatile stocks exhibiting a higher probability for this event. To avoid the associated estimation problems in a parametric framework we use a simple proxy for stabilization. Assuming that stabilization will take place in the close proximity of the issuing price we count the trading days for which the stock price was at or below 95% of the issue price over the first twenty trading days. We chose this value for the 'intervention level' since (roughly speaking) the underwriter has an incentive to buy shares on the secondary market only at a price below $(1 - f) E$. If stabilization is actually performed and if it also has the desired effect, then we should find that the relative frequency of a price below 95% of the issue price is significantly lower for issues with an OAA than for the rest of the sample. This definition of price stabilization can only be applied to issues with less than 5% overpricing, since otherwise the stock price has already fallen to 95% of the issuing price from the start. 281 of the 300 issues in our sample satisfy this restriction. 254 of the 281 issues featured an OAA (90.39%). Among this group of issues 73 had at least one trading day where the stock price had fallen to 95% of the issue price or below, representing 25.97% of all underpriced issues. It is now interesting to look at the relative share of the firms with and without an OAA, respectively. If our simple measure of price support is valid, and if underwriters indeed perform stabilizing activities, then we should see a significantly larger percentage of non-OAA firms in the group with share prices below 95% of the issue price

than in the overall population of underpriced issues. As our analysis shows, the relative share of firms without an OAA in the group of firms suffering a price drop below 95% of the issue price is 8.22% (6 of 73), whereas 91.78% are firms with an OAA. Thus these percentages are almost identical to the share of firms with and without an OAA in the overall sample. So at least from this simple statistic we cannot conclude that the existence of an OAA pays off for the IPO investors by generating a better protection against falling prices in the aftermarket.

One might argue that this absolute measure does not tell the whole story, since it could be that issues with OAAs were mainly brought to the market in times of lower overall returns, so that it would have been much more difficult to prevent aftermarket prices from going below our critical mark of 95% of the issue price. To see whether our result might be influenced by the performance of the market as a whole we also compute the frequency with which the Nemax All Share Index fell to or below 95% of its value at the respective issue date of a given firm over the first 20 days of the listing of this company.

Out of the six cases of non-OAA firms suffering losses of at least 5% of the issue price at least once over the first 20 trading days, three are observed for periods when the Nemax Index had also shown a loss of at least 5% relative to the issue date at least for one trading day. For firms with an OAA we find that in 47 out of 67 cases the Nemax Index had a performance that was comparably weak, so that the effect could here be driven by a worse overall market performance. However, there is no statistically significant difference between the two groups, which is mostly due to the very small sample size for the non-OAA group. So also with respect to this criterion we cannot find any significant differences between OAA and non-OAA companies.

As mentioned above we finally want to analyze the market-adjusted performances of firms with and without OAAs over the first 21 trading days on the secondary market.

However, to make sure that differences in returns are not systematically affected by differences in market risk exposure, we compute residual returns from a standard market model. The beta coefficient for each stock is estimated by a market model regression using 60 returns immediately following the 21 days over which performance should be compared between OAA and non-OAA firms. The results are shown in table 5. The median firm with an OAA has a beta-adjusted return of –9.9% over the first twenty-one trading days, whereas the typical non-OAA firm strongly underperforms the market by –74%. The other descriptive statistics in table 4 show that the market model residuals for firms with OAAs are also more volatile, consistent with the earlier finding from table 3 that returns are in general more volatile for OAA firms. Despite the large numerical difference between the two medians, the Kruskal-Wallis test cannot reject the hypothesis of equal medians in the two groups of issues. So also for this performance measure we cannot detect any statistically significant differences between issues with the extra feature of an OAA and those without.

## 5. Summary and Conclusion

In this paper we have analyzed OAAs in IPOs on the Neuer Markt in Germany. The main question we have dealt with is whether there are empirically detectable benefits for the groups granting these extra rights to the underwriting bank. As a first step in such an investigation it has to be shown that such an OAA has indeed a value that is high enough to be of economic importance. For the stocks in our sample the mean extra value amounts to roughly 3%, which is more than half the average underwriter gross spread. Even if our estimate is just regarded as an upper bound to the additional value of an OAA beyond the gross spread, there should be no doubt about its economic significance. Our computations are based on the interpretation of an OAA as a combination of two contingent claims, a call option and a short forward with a forward price that does not create a zero value for the

contract initially. This interpretation differs from what is found in other papers, which only consider the call option part, resulting in a substantial over-estimation of the OAA value in the case of underpricing. Furthermore, seen from our perspective an OAA now generates an incentive for the underwriting bank to reduce underpricing, opposite of what has sometimes been argued in the literature.

Having shown that OAAs represent significant value to the underwriting banks, we empirically tried to detect differences between firms having granted OAAs in their IPOs and those having gone public without this extra feature. Besides differences in a few firm characteristics like size or return volatility, we do not find any other variables that are statistically different for OAA and non-OAA firms. Especially, the existence and value of an OAA had no significant impact on the amount of underpricing, as tested in a two-stage least squares approach. Also there does not seem to be a more pronounced price support for OAA firms, and also the performance over the first month in the aftermarket is not statistically distinguishable, once returns are adjusted by market model betas.

To sum it up, based on our data set we find no evidence that pre-IPO shareholders receive any benefits in return for granting a valuable OAA to the underwriting bank. Thus, our focus of attention becomes the argument, that through the OAA underwriting banks receive the opportunity to allocate an extra fraction of particularly attractive and oversubscribed shares to preferred clients. In 201 of the 269 issues with an OAA, the GS was ultimately placed in the market. And indeed, about two thirds of these issues were underpriced by more than 20% and can therefore be regarded as particularly attractive. On a

market characterized by a growing competition between underwriting banks,[26] an instrument that allows the underwriting bank to build and promote client relationships and to enhance reputation should be very desirable from their point of view. This is all the more true if the OAA is available to them 'for free'. To provide empirical support for this hypothesis it would, however, be necessary to use detailed data on the process of the share allocation in IPOs. This remains an exciting topic for future research.

[26] See Franzke (2001) who shows that the previously dominant role of Deutsche Bank in the underwriter market has recently been reduced. In an empirical study on Neuer Markt covering the time period from March 1997 to December 2001 the author finds 48 different *lead* underwriters and 103 different underwriters in total.

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Table 1: Descriptive Statistics

| Year | Number of issues per year (% of all issues) | Average issue size (including OAA, in millions of EURO) | Issues with OAA (% of issues in that year) | OAA provided by pre-IPO shareholders (% of issues with OAA) | Average percentage of OAA volume relative to total issue | OAA exercised (% of issues with OAA) | Average gross spread (% of issuing proceeds) | Number of underpriced issues (% of issues in that year) | Average underpricing |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 8 (2.67%) | 24.260 | 5 (62.50%) | 3 (60.00%) | 17.22% | 5 (100.00%) | 4.72% | 8 (100%) | 56.92% |
| 1998 | 37 (12.33%) | 39.914 | 28 (75.68%) | 15 (53.57%) | 12.46% | 27 (96.42%) | 5.36% | 37 (100%) | 85.20% |
| 1999 | 121 (40.33%) | 49.852 | 110 (90.91%) | 61 (55.45%) | 12.53% | 84 (76.36%) | 5.10% | 92 (76.03%) | 44.38% |
| 2000 | 124 (41.33%) | 101.881 | 116 (93.55%) | 85 (73.28%) | 12.52% | 81 (69.83%) | 5.41% | 95 (76.61%) | 47.27% |
| 2001 | 10 (3.33%) | 50.271 | 10 (100.00%) | 9 (90.00%) | 13.31% | 4 (40.00%) | 5.46% | 3 (30.00%) | 10.49% |
| Total | 300 (100.00%) | 69.463 | 269 (89.67%) | 173 (64.31%) | 12.63% | 201 (74.72%) | 5.26% | 235 (78.33%) | 49.81% |

The sample period covered is March 10, 1997 to December 31, 2001. The original sample consisted of 352 issues, 52 of which had to be deleted due to either data problems, extreme values for issue size, or because the issue merely represented a change of market segment. OAA: Over-allotment arrangement.

Table 2: Upper Bound on Values of Over-Allotment Arrangements

| | Volatility | Value (proxy: last pre-IPO mid quote) | Value (proxy: issue price) | Gross spread (% of issuing proceeds) |
|---|---|---|---|---|
| Mean | 0.780 | 2.99% | 6.33% | 5.27% |
| Std. Dev. | 0.349 | 4.04% | 3.74% | 1.22% |
| Median | 0.719 | 1.50% | 5.65% | 5.20% |
| 10%-quantile | 0.411 | 0% | 2.39% | 4.07% |
| 90%-quantile | 1.249 | 8,24% | 10.98% | 6.21% |
| No. obs. | 269 | 256 | 269 | 269 |

The value of the over-allotment arrangement was computed using the Black-Scholes model. The volatility was estimated using 20 daily returns after the expiration of the OAA. Two values are computed: one is the value using the last pre-IPO quote midpoint as a proxy for the initial stock price, the other uses the issue price as this proxy. The value of the over-allotment option is created in excess of the present value of the gross spread on the additional shares. No. obs.: Number of observations. OAA: Over-allotment arrangement.

Table 3: Characteristics of Issues With and Without OAA

| Variable | Mean 'OAA' | Mean 'No OAA' | *p*-value | Median 'OAA' | Median 'No OAA' | *p*-value |
|---|---|---|---|---|---|---|
| Book value of assets | 30,191 | 16,533 | 0.1810 | 13,510 | 8,096 | 0.0186 |
| Issue volume without GS | 2,978,978 | 1,222,525 | 0.1231 | 2,000,000 | 1,000,000 | >0.0001 |
| Issuing price in EURO | 24.82 | 26.26 | 0.5857 | 22.00 | 23.01 | 0.5557 |
| Opening price in EURO | 38.76 | 46.22 | 0.2532 | 28.00 | 30.00 | 0.5140 |
| Use of book building range in % | 79.65 | 67.67 | 0.1258 | 100 | 100 | 0.2502 |
| Total flotation costs in % of issuing proceeds | 8.89 | 8.85 | 0.9505 | 8.27 | 8.71 | 0.6635 |
| Gross spread in % of issuing proceeds | 5.27 | 5.17 | 0.6588 | 5.20 | 5.20 | 0.6923 |
| Underpricing | 48.83 | 58.34 | 0.4938 | 17.50 | 30.00 | 0.4210 |
| Annual. volatility of 20 daily returns in % (Opaqueness) | 90.01 | 76.53 | 0.0884 | 81.84 | 73.14 | 0.0910 |

The data set consists of 269 issues with and 31 issues without OAA. Underpricing is measured as the spread between the initial offering price and the opening price at the first day of trading. The test for differences in medians is the Mann-Whitney test.

## Table 4: OAA, Non-Underwriting Expenses, and Underpricing

A two-stage least squares approach is used to test the hypothesis that companies which go public at Neuer Markt and grant an OAA to the underwriting bank exhibit lower underpricing. The variables in the table are the percentage underpricing based on Schnigge quotes or issuing prices (*underpr. (Schnigge), underpr. (issuing price* ), the value of the OAA per share in percent of the issuing price, also based on Schnigge quotes or issuing prices (*OAA (Schnigge), OAA (issuing price)*), non-underwriting expenses (*exp*), the participation ratio ($n_{0,s}$), the annualized volatility of the 20 daily returns from day 1 to 21 after the IPO (*volatility1*), the annualized volatility over the 21 days immediately following the first 21 trading days (*volatility2*), the log of the number of employees (*empl*), the extent to which the book-building range was exhausted (*bookb*), the performance of the NEMAX index over the forty days prior to the IPO (*NEMAX*), the Euribor rate (*euribor*), and the log of the issuing volume (*ln_volume*). All *t*-statistics are based on White's heteroskedasticity-consistent standard errors. The corresponding *p*-values are given in parentheses.

| | (1) *underpr* (Schnigge) | (2) *OAA* (Schnigge) | (3) *exp* | (4) *underpr* (issuing price) | (5) *OAA* (issuing price) |
|---|---|---|---|---|---|
| *Constant* | 0.356 (0.1736) | - 0.007 (0.4071) | 5.107 (0.0000) | 0.313 (0.2182) | - 0.022 (0.000) |
| $n_{0,s}$ | - 0.167 (0.7066) | | 1.141 (0.0866) | - 0.140 (0.7492) | |
| *volatility 1* | | 0.075 (0.000) | | | 0.104 (0.000) |
| *volatility 2* | 0.245 (0.0127) | | | 0.251 (0.0126) | |
| *empl* | - 0.077 (0.0456) | | | - 0.070 (0.0629) | |
| *bookb* | 0.239 (0.0006) | | | 0.232 (0.0004) | |
| *NEMAX* | 1.273 (0.0000) | | | 1.270 (0.0000) | |
| *exp* | 0.100 (0.4662) | | | 0.127 (0.3287) | |
| *euribor* | | - 0.154 (0.5032) | | | - 0.017 (0.9027) |
| *OAA* | 0.056 (0.9637) | | | - 0.299 (0.7226) | |
| *Ln_volume* | | | - 0.304 (0.0000) | | |
| *underpr* | | - 0.039 (0.0000) | 0.067 (0.4825) | | - 0.001 (0.6786) |
| Adj. $R^2$ | 29.76% | 47.39% | 16.37% | 30.28% | 78.27% |
| No. obs. | 285 | 285 | 298 | 298 | 298 |

Table 5: Market-Adjusted Performance of Issues With and Without OAA

| | With OAA | Without OAA |
|---|---|---|
| Mean | 0.261 | -0.693 |
| Std. Dev. | 3.300 | 2.778 |
| Median | -0.099 | -0.739 |
| 10%-quantile | -3.557 | -3.521 |
| 90%-quantile | 4.661 | 2.315 |
| No. obs. | 269 | 31 |
| KW | 2.379 (0.123) | |

Beta-adjusted performance is measured as the annualised difference between the log-return of the stock and the log-return of the Nemax All Share Index multiplied by the estimated beta coefficient for the stock. Performance is measured over the first 21 trading days of the stock on the secondary market, beta is estimated using the 60 returns immediately following this period. KW is the chi square statistic of the Kruskal-Wallis test (*p*-value in parentheses).