IPO Pricing and the Relative Importance of Investor Sentiment – Evidence from Germany*

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Abstract:

The underpricing phenomenon of Initial Public Offerings (IPOs) has been widely studied across different stock markets around the world and has often been explained to be a result of asymmetrically distributed information and ex-ante uncertainty. However, as Ritter and Welch (2002) argue, these theories are unlikely to explain the persistent pattern of high initial returns during the first trading day. This paper focuses on the importance of investor sentiment and of information gathered by the underwriter before the start of the bookbuilding process. The cross-sectional regression analysis, using both censored and uncensored data, shows that the initial returns are mainly influenced by investor sentiment and uncertainty about the potential demand concerning the forthcoming IPO, and less by ex-ante uncertainty about the underlying firm's value.

JEL Classification: G10, G12, G24, G32

Key Words: Initial Public Offerings (IPO), Underpricing, Investor Sentiment, Hot-issue Markets, Ex-ante Uncertainty

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1 Introduction

A systematic increase from the offer price to the first-day closing price has been documented for initial public offerings (IPOs) since the early 1970s. From an issuer's point of view this phenomenon is usually called underpricing, as it describes the additional amount of money which could have been raised by the issuer if the offer price had been set at an appropriate level.

A range of theoretical explanations, which are not mutually exclusive, has been advanced to explain why owners of a company would rationally sell shares to outsiders for less than the apparent maximum price achievable (Loughran and Ritter, 2002). In their analysis, most researchers assume that underpricing is a deliberate act by either the underwriter or the issuer as a result of asymmetric information and is therefore due to their ex-ante uncertainty. Given the empirical findings, especially of high initial returns during the dot-com boom, one can ask the following questions about the suitability of 'traditional' explanations: First, why are underwriters and issuers not able to reduce the amount of money left on the table and why do firms prefer to go public during these periods and therefore give away such a significant amount of money? Second, and most important, why is the degree of underpricing highest during periods when investors appear to be most optimistic?

Ljungqvist (2004) comes to the conclusion that IPO researchers should focus more on behavioral approaches to clarify why the extent of underpricing varies so much over time. In our opinion, the notion of bounded rationality seems to be important to explain the unusually high initial returns during the dot-com boom. Dorn (2003) shows while analyzing pre-IPO trading for the German stock market that investors are willing to overpay for IPOs. Bartov, Mohanram and Seethamraju (2003) report that a dummy variable for risky IPOs has no effect on the setting of the final offer price, providing evidence for the argument that risk might not be that important for the

pricing of IPOs. Purnanandam and Swaminathan (2004) show for the U.S. stock market that the median IPO is overvalued by 50 % compared to its matched industry benchmark. Combining these empirical findings, one has to conclude that IPOs were not necessarily sold too cheaply but at a price which made the IPO a success for the issuer despite underpricing. The offer price, set using information about the expected demand for the IPO gathered during and prior to the bookbuilding process, represents some sort of initial upper bound in the sense of Tinic's (1988) legal liability hypothesis.

The importance of investor sentiment was introduced and analyzed in the context of the underpricing phenomenon by Ljungqvist, Nanda and Singh (2004). They show that underpricing, long-run underperformance and hot-issue markets can be explained by the presence of sentiment investors. The notion of sentiment characterizes the presence of irrational investors who show undue interest in IPOs. Due to this irrational exuberance, rational investors are willing to pay a price above their fundamental value as they are able to sell their stock to sentiment investors at any time. Cook, Jarrell and Kieschnicke (2003) examine this model empirically and conclude that "the role of investor sentiment is more important than previously thought". Cornelli, Goldreich and Ljungqvist (2005) find evidence for the presence of sentiment demand and its power of influence on newly listed firms by analyzing pre-issue trading in Europe. Baker and Wurgler (2004) show that, contrary to classical finance theory, investor sentiment influences the cross section of stock returns. Moreover, Purnanandam and Swaminathan (2004) find that the more overpriced an issue is compared to similar existing firms, the worse its long-run performance. Drake and Vetsupens (1993) find that sued IPOs had a higher initial return and therefore they conclude that underpricing did not protect them from being cited before the court. These results show once more that the market appears to be irrationally optimistic towards IPOs in the short run and therefore strong demand towards IPOs causes the rise of the stock price during the first trading day.

In our study we try to differentiate between the effects of investor sentiment and ex-ante uncertainty to ascertain which factor is more capable of explaining the high initial returns during the period of the dot-com boom. In order to accomplish this we do not focus on survey data about sentiment or other proxies for sentiment like the holdings of large (institutional) investors, put-call ratios, trading volume or closed-end fund discounts. There is an ongoing inconclusive debate about the effectiveness and explanatory power of many investor sentiment measures (Qui and Welch, 2004). Instead we focus first on the bookbuilding range and the subscription period which are set by the underwriter after observing the potential demand (i.e. investor sentiment) for the stock to be issued and second on the explanatory power of pre-IPO trading, stock market performance prior to the issue and the usage of the so-called greenshoe option.

In Europe, the length of the bookbuilding period and the width of the bookbuilding range are set after a pre-marketing period. During this time span IPO research from sell-side and buy-side analysts is produced and distributed by syndicate members to institutional clients (Jenkinson, Morrison and Wilhelm, 2005). As a result, the length of the subscription period and the width of the bookbuilding range are good indicators of how strong the underwriter expects potential demand to be. The longer the subscription period and the wider the initiative price range the more uncertain is the underwriter about possible success and the higher is the uncertainty about potential demand. This view is supported by the argument of Jenkinson, Morrison and Wilhelm (2005) who assert that *ceteris paribus* less available information will lead to an increase in the bookbuilding range. Another institutional feature makes these suggested relationships appealing for the analysis of investor sentiment. In Germany an IPO can only be priced outside the initial price range if the underwriter cancels the actual bargaining and re-offers the IPO. If this takes place, the underwriter has to state a new price range and new subscription period which must have a damaging effect on the quality and success of the initial offering.

In the U.S. pre-IPO trading (or 'grey' market trading) in IPO shares is prohibited. On the contrary, most European countries have a grey market for IPOs, where investors can speculate on future stock prices of companies that are in the process of going public. 'Grey' market trading is mostly organized by independent brokers and Schnigge AG has a dominant position. The pre-IPO trading market can be described as rather liquid; the quoted spreads are observable from the broker or through the media e.g. Reuters or Bloomberg - a clear indicator of the popularity of pre-IPO trading in Germany. As a result we are able to assess pre-IPO valuation by predominantly small investors (for a detailed analysis see Cornelli, Goldreich and Ljungqvist, 2005). Price variation in this period can be substantial; during the dot-com bubble closing pre-IPO trading prices were frequently higher than the upper bound of the indicative price range (Dorn, 2003). Aussenegg, Pegaret and Stomper (2004) consequently note that underwriters can gauge the market's interest in an IPO by observing pre-IPO trading.

During the dot-com boom the European IPO market attracted more IPOs in the years 1998 to 2000 than the U.S. stock market (Ritter, 2003). As of 2000, the peak of the IPO boom, the Frankfurt stock exchange became the most important stock market in Europe in terms of issue activity, liquidity and market capitalization of 'New Economy' stocks. After the burst of the bubble issue activity, especially in Germany, came to a standstill. These dynamic patterns make IPO research on the Germany stock market instructive in general as well as interesting in it's own right. However, difficulties in constructing a sound empirical database have meant that detailed studies of the underpricing phenomenon in the German stock market are limited in number and therefore another goal of this article is to provide a thorough analysis of this period in Germany. Limited availability of databases mean that one mainly has to rely on hand-collected data for an empirical analysis of the German IPO market. We use different and independent data sources for collecting the necessary

information in order to ensure reliability. Our regression universe covers 410 IPOs over the years 1997 to 2001. The sample is reduced to 354 firms when we include pre-IPO trading prices.

We analyze different industry sectors as well as different stock market segments and find that underpricing is highest on the 'Neuer Markt', a stock market segment established for young and fast growing companies in March 1997. This is consistent with the results of Loughran and Ritter (2004) and Ljungqvist and Wilhelm (2003), amongst others, who focus on the 'New Economy' sector in the U.S. Our analysis of the cross section of IPOs between 1997 and 2001 uses both censored and uncensored data estimation methods. Tobit methods are used to accommodate the influence of price support in truncating the distribution of the dependent variable. We conclude from our estimation that underpricing is mainly influenced by investor sentiment and, therefore, by the demand of potential investors, and less by ex-ante uncertainty, especially during the dot-com boom.

The paper is organized as follows. Section 2 briefly sheds some light on theoretical aspects and selected previous research and presents the hypotheses that motivate the data analysis. Section 3 describes the data set and gives a short overview of the German stock market. Section 4 describes the firm characteristics and presents results on the impact of analyzing industry groups, market segmentation, dynamics of the IPO cycle and presents the cross-sectional regression results. Section 5 concludes our analysis.

2 Theoretical background and explanatory variables

The aim of this section is not to review the IPO literature in general but to give a selected view of the research which influences our analysis and to describe the explanatory variables. For up to

date and excellent literature reviews see Loughran and Ritter (2002), Ritter (2003) and Ljungqvist (2004) and for excellent book length coverage see Jenkinson and Ljungqvist (2001).

Ritter and Welch (2002) summarize the valuation- and information-related topics of the underpricing phenomenon as follows:

> "… the solution to the underpricing puzzle has to lie in focusing on the setting of the offer price, where the normal interplay of supply and demand is suppressed by the underwriter."

Therefore, there are only two different but not mutually exclusive scenarios which could lead to the observable pattern of high initial returns at the first trading day. First, it could be possible that the offer price is set too low due to ex-ante uncertainty about the true market value of the IPOs. Second, the offer price might be on average at a 'fair value' but demand for new issues is overwhelmingly high and therefore generating the observed high initial returns during the dot-com boom. [1]

The first strand of literature focuses on the ex-ante uncertainty surrounding the true value of the firm due to asymmetrically distributed information. This uncertainty arises from the fact that the issuer or underwriter (if there are no agency conflicts between them) is better informed than the investors. This generates adverse selection and signaling problems: high-quality issuers can afford to sell their shares at a lower price, i.e., leave money on the table, because they trust in future

[1] These arguments show that initial returns and underpricing, which are commonly used interchangeable in prior research, describe different effects, even if measured identically as the difference between the offer and first day trading price of an IPO. Therefore, the notion of *underpricing* describes the increase in share prices between primary and secondary market that are due to a discount on the offer price. By contrast, the notion *initial return* refers to an increase due to the impact of investors demand on the in the first day trading price

issuing activity and analyst coverage (Welch, 1989; Chemmanur, 1993). Alternatively, there exists the possibility that groups of investors are differentially informed which leads to the well known winner's curse described by Rock (1986), or to a (negative) informational cascade as investors judge the sentiment or interest of other investors (Welch, 1992; Amihud, Hauser and Kirsh, 2003). Benveniste and Spindt (1989) develop a model in which underwriters reward better informed investors for truthfully revealing their private information by selling stocks to be issued at a discount.

Ritter and Welch (2002) argue that these theories are unlikely to explain the persistent pattern of high initial returns during the first trading day. Additionally, they discuss that over-enthusiasm among retail investors may explain the pattern of high initial returns. This argument is supported by Ljungqvist (2004) who comes to the conclusion that IPO researchers should focus on behavioral approaches to explain why the extent of underpricing varies so much over time. Therefore, the second strand of research focuses on behavioral finance and bounded rationality in order to explain the pattern of time variance and persistence of initial returns. From our point of view the notion of investor sentiment seems to be most promising. This approach argues that high and fluctuating initial returns are caused by irrational investors who show strong interest for IPOs. Supporting this argument Shiller (1984) and Summers (1986) show that, due to limits of arbitrage, irrational traders might influence stock prices to a substantial degree. This situation is especially important for the analysis of the dot-com boom as during this period nearly all investors appeared to believe in an endlessly increasing stock market and therefore the holding of a short or opposed position could be expected to be very costly. Cornelli, Goldreich and Ljungqvist (2005) find that high pre-IPO prices, which indicate overly optimistic investors, are a good predictor of high initial returns during the first trading day.

In order to distinguish between the two strands of research we run several regressions in which we use the variables described below and who's properties are briefly summarized in Table 1.

Please insert Table I around here

Ritter (1984) argues that a high degree of uncertainty prevails about the fundamental values of new issues. This is especially important if the operating history of a firm is short. Therefore, in a regression explaining the initial return, a negative sign on the variable *age* is expected. *Age* is calculated as the difference between the foundation date of the company and the date of the IPO.

A similar line of argument underlies the assumption of Beatty and Ritter (1986) that smaller IPOs suffer from higher underpricing due to their inherent riskiness. To measure this effect the size of the issue has been used as explanatory variable. We use instead the market capitalization at the time of the IPO and take the inverse as in Beatty and Ritter (1986) to form the variable *invmarketcap,* as we believe that the market capitalization is a better measure for the size of the IPO. We expect a positive sign.

Jenkinson, Morrison and Wilhelm (2005) show that, in Europe, the length of the bookbuilding period and the width of the bookbuilding range are set after a pre-marketing period. Therefore, the underwriter and issuer have information on the potential demand for a new issue before they launch the indicative prospectus. Additionally, if the issuer or underwriter is unsure about the potential demand for the stock to be issued, they will increase the period in which the investors can place orders. This last argument is again supported by Jenkinson, Morrison and Wilhelm (2005) who assert that, *ceteris paribus*, less available information will lead to an increase in the bookbuilding range. One would expect that this argument is true for the subscription period as well.

The variable *bbd* is calculated as the difference between the start and the end of the subscription period and the variable *bbw* is calculated as the difference between the upper and lower bound divided by its midpoint. We expect, given the argument above, a positive sign on both variables if the ex-ante uncertainty hypothesis holds.

Considering the dynamics of the IPO market cycle and increasing investor sentiment we expect that more companies have an incentive to go public and to take advantage of the 'window of opportunity' during so called hot-issue periods (Loughran and Ritter, 1995). Lowry (2003) finds a positive correlation between the closed end fund discount and the issue activity. In order to account for the timing effect of the decision to go public we use the variable *volume* which is calculate as the total number of new issues during the last 30 days prior to an IPO. Due to the fact that issue activity tends to increase when underpricing is high and underpricing tends to decrease when issue activity is highest, the sign clearly depends on the state of the IPO cycle (Ritter, 1984; Lowry, 2003). Moreover, when many firms are conducting their initial offering within a short time period potential investors have to split their investment between the different IPOs and therefore *ceteris paribus* lower demand per IPO may lead to a decrease in initial returns. Hence, in our analysis a negative sign on volume is expected as underpricing is at a peak in our sample.

Cornelli, Goldreich and Ljungqvist (2005) note that through 'grey' market trading we are able to assess pre-IPO valuation by predominantly small investors. Cornelli, Goldreich and Ljungqvist (2005) focus on the midpoint of the final bid-ask spread before the official start of trading. Löffler, Panther and Theissen (2004) analyze the effectiveness of the IPO pricing process while analyzing pre-IPO bid-ask-spreads. Ljungqvist and William (2003) use the price revision, calculated as the difference between expected offer price and final offer price, in order to explain the unusually high initial returns during the dot-com bubble. We combine these methodologies and compute a dummy variable which is coded one if the grey market price, calculated as the midpoint of the final pre-IPO

bid-ask-spread is above the expected offer price, calculated as the midpoint of the bookbuilding range and zero otherwise We expect a positive sign for the dummy *grey market* as pre-IPO trading should be a strong indicator for demand during the IPO pricing period.

More generally, we suggest that underpricing of IPOs can be attributed to rising stock markets and that initial returns are at least partly predictable based on market returns as recently noted by Loughran and Ritter (2002) and Derrien (2005). The variable *nemax* is therefore calculated as a buy-and-hold return of the 'Nemax All Share'-index which represents all shares traded at the market segment 'Neuer Markt' for 30 days prior to the IPO. The sign on *nemax* is expected to be positive, as a rising stock market, indicating a positive investor sentiment, should also increase initial returns.

Due to the greenshoe[2] option, the underwriter is able to buy additional shares from the issuer at the issue price in order to meet excess demand (Aggarwal, 2000). Therefore, we use the dummy variable *greenshoe* which is coded one if the option has been exercised by the underwriter and zero otherwise, in order to detect strong demand for an IPO. Consequently, we expect a positive correlation between this explanatory variable and initial returns.

Additionally, Ljungqvist (1997) argues that underpricing could be influenced by general macroeconomic conditions and their observation by investors (business climate). In order to incorporate this effect, the business climate index of current and future business expectations for Germany from the OECD statistics[3] is used in our study, similar to Ljungqvist (1997).

[2] The overallotment or greenshoe option has been named after the Greenshoe Manufacturing Company as this firm was the first to go public while using this type of a call option

[3] This index is calculated by the OECD, as the geometric mean of the present and future business situation. The result is based on the business tendency survey reflecting business men's judgment on developments experienced during the past month (i.e. 30/31 days), their assessment of the current situation, and their expectations during the next six month for their own business.

Consequently, the variable *bc* should have a positive sign as optimism in the economy should be accompanied by an increase in the stock market.

Loughran and Ritter (2004) show for the U.S. stock market that the amount of underpricing is influenced by the prestige of the underwriter. A similar result is confirmed for Germany by Wasserfallen and Wittleden (1994). Krigman, Shaw and Womack (1999) show in their analysis that issuers tend to select underwriters based on their ability to attract media attention. Prestige is hard to measure, so to be more specific we use the IPO-experience of the underwriter. The dummy variables we create are based on measuring the number of IPOs brought to the market as lead underwriter. We rank the underwriters according to their experience as lead underwriter and group them into three quantiles. Our dummy variables *underwriter1* and *underwriter2* take the value one if the underwriter belongs to the first or second quantile, respectively, and zero otherwise.

Some industry groups and especially firms belonging to the so called 'New Economy' seem to be more likely to experience higher initial returns. Loughran and Ritter (2002) report especially high initial returns for internet and technology stocks, Ljungqvist and Wilhelm (2003) for internet and high-tech companies and Lowry and Schwert (2002) for the 'high tech' industry. Unfortunately, there is no consensus about how to form this group of firms. We assemble the 'New Economy' group from the industry groups: media, pharma&health, software, technology and telecommunication. The dummy variable *new economy*, which is used to test the robustness of our results, takes the value one if the IPO belongs to the 'New Economy' and zero otherwise.

In the same way we are testing the effect of the stock market segment 'Neuer Markt', which was created by the Deutsche Börse AG in 1997 for fast growing and innovative companies. During the IPO boom period this stock market segment has been closely watched by media and analysts. The attractiveness for issuers to list on this stock market segment can be shown by looking at the development of the Nemax All Share Index covering all stocks traded at the 'Neuer Markt'. This

index rose from a starting value of 500 in March 1997 to a peak of more than 8300 in March 2000 and therefore increased by more than 1,660 %. The dummy variable *neuer markt* is coded one if the firm went public on this stock market segment and zero otherwise.

3 Dataset

3.1 Essential features of the German stock market

German secondary equity markets are fragmented both vertically and horizontally. In the horizontal dimension, stock trading is segmented into eight regional exchanges and one electronic trading system XETRA which is operated by the Deutsche Börse AG. While the most liquid stocks are cross-listed on all stock markets, the Frankfurt Stock Exchange covers more than 90 percent of the German equity market. Therefore this stock exchange is by far the largest competitor and is run by the Deutsche Börse AG, too. The other stock exchanges are located in Berlin, Bremen, Düsseldorf, Hamburg, Hanover, Munich and Stuttgart. In our analysis, we focus on the Frankfurt Stock Exchange due to its dominant position within the stock market and especially regarding issue activity.

Until 5th of June 2003, the vertical fragments at the Frankfurt Stock Exchange mainly consisted of three regulated market segments and two additional segments under private law (for an overview and more details see http://deutsche-boerse.com/dbag/). The ‘Amtlicher Handel’ created as a regulated segment for most of the liquid stocks was complemented by the ‘Geregelter Markt’ in the mid-eighties as a special segment for small- and mid-caps. The ‘Freiverkehr’ is a nearly unregulated inter-broker trading segment. The ‘Neuer Markt’ was founded in 1997 as a secondary market to support German growth stocks. Later on, an additional segment, the ‘SMAX’, was created for small caps from the old economy where the listing requirements were lower than in the ‘Neuer Markt’,

but higher than in the traditional ‘Geregelter Markt’ (For a detailed overview about the design of the German stock market see Theissen, 2004).

3.2 Description of the dataset

The dataset employed in this paper covers the period 1997-2001 and contains all initial listings on the Frankfurt Stock Exchange. Companies being traded nationally or internationally before going public on the Frankfurt Stock Exchange have been excluded. Therefore, our ‘sample universe’ consists of 424 firms. Data for some explanatory variables, which are used for the cross sectional analysis, like bookbuilding range, subscription period or foundation year are not available for 14 IPOs. Therefore, our analysis mainly covers 410 firms. The closing prices of pre-IPO trading were only available for 354 firms. Therefore, the regression analysis incorporating pre-IPO trading prices is limited to a reduced sample of 354 firms.

The German stock market has been very much en vogue for IPOs during the dot-com boom. In contrast to this, research on the IPO market has been limited to small datasets, traditional variables or short periods as most of the necessary data is not available in professional databases. To overcome this constraint, most of our data is hand-collected from different sources. To ensure the reliability of the dataset we have always used at least two different and independent data sources and cross-checked every single figure and number in our dataset using alternative sources. The combination of different sources was necessary as not all databases provide information on all our variables.

To give an example, the companies’ age has been collected from the companies’ home-pages or the IPO prospectus and has been double checked using the data base of OnVista AG and ‘Börsenzeitung’, two leading news providers, Comdirect AG, a leading direct broker and finally,

the web pages of the Deutsche Börse AG. If we got contradictory figures, we asked the companies investor relations department via email or telephone for the foundation year of the company.

Initial Public Offerings are taken from the Frankfurt Stock Exchange web pages and factbooks, and always double checked with the IPO prospectus, company's homepage or investor relations department, the IPO database of the 'Börsenzeitung', and the IPO database of OnVista AG, in order to explore missing firms and entities which have been publicly traded before.[4]

The company's foundation year is taken from the IPO prospectus, the company's web pages or the investor relations department, the databases of OnVista AG, 'Börsenzeitung' and Comdirect AG. The information about the bookbuilding period and price range are collected from the IPO prospectus, the Frankfurt Stock Exchange web pages or the IPO databases of 'Börsenzeitung' and OnVista AG. The indication of use of the greenshoe is taken from the 'Börsenzeitung', ad-hoc information services or the company's investor relations department. The information about the number of issued stocks is taken from the IPO prospectus and Deutsche Bank IPO database. The information about the underwriter is taken from the Frankfurt Stock Exchange, IPO prospectus, and 'Börsenzeitung'. Industry classification (C-DAX classification) is taken from the Frankfurt Stock Exchange web pages or from OnVista AG, 'Börsenzeitung', and Comdirect web pages. We obtained 'grey' market priced from Schnigge AG, the leading broker for pre-IPO trading in Germany.

The secondary market prices are obtained from the KKMDB database at the University of Karlsruhe.[5] Daily closing prices of the different stock market indices are taken from Datastream. The business climate index is from the monthly OECD statistics.

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[4] WindWelt for example was missing on the web pages and Factbooks of the Deutsche Börse AG.

[5] We thank Hermann Göppl for providing the data.

4 Empirical analysis

4.1 Firm characteristics

To provide general information, Table II shows some details based on descriptive statistics for each year and the whole sample period. We split data for the year 2000 into two sub periods for our descriptive analysis because in March 2000 the price bubble started to burst. We have chosen January to July for the first sub period as after July the number of IPOs decreased sharply and the stock market experienced another decline but this time even more severe. To use March instead of July, the peak of the stock market indices for separating the sample would not take the well documented conservatism phenomenon into account, which states that investors need some time to finally realize a sentiment change.

Please insert Table II around here

The issue volume which has been calculated by including the exercised greenshoe has an average of € 107.97 million over the sample period and is highly skewed (the median is only € 36.79 million) due to some big offerings. The smallest issue was OAR Consulting in 1998 at € 4.3 million and the largest IPOs were Deutsche Post in November 2000 at € 5,842 million, Infineon in March 2000 at € 5,379 million and T-Online in April 2000 at € 2,538 million. Hence, the biggest IPO is 1,358 times bigger than the smallest. The issue volume fluctuates quite substantially peaking in 2000 due to big offerings in the second sub-period. These figures are much higher than for earlier

years. For example, Ljungqvist (1997) reports[6] for 1970-1993 a mean of DM[7] 134.7 million (€ 68.87 million) and median of DM 57.2 million (€ 29.25 million).

Examination of market capitalization which provides a better feel for the range of company sizes compared to the issue size, as it also covers shares retained by the issuer, demonstrates that the biggest firms were brought to the public in 2000 and 2001. The largest firm measured in market capitalization at the IPO date was Infineon with € 1,584 million. This shows that big firms either do not care much about the stock market sentiment or are simply too slow to react fast enough to a short lived IPO boom. The clear decrease in median but slow decrease in the mean supports this idea. Jindra (2000) finds in his analysis for the U.S. market that a small number of firms issue seasoned equity while they are undervalued. Examining this group, he explores the idea that this cluster consists mainly of large and old companies issuing little equity. Similarly, in our sample the age of the companies increases in the second sub period of 2000 and in 2001, and the issue volume decreases because the median of the issue volume drops rather sharply.

The average firm age of 17.59 years compared to 52 years reported for the earlier years by Ljungqvist (1997) suggests that the majority of firms which went public during the sample period on the Frankfurt Stock Exchange are relatively recently founded firms. This idea is supported by the observations of a low sample minimum of 0.98 years and a median of 10.32 years. Ljungqvist and Wilhelm (2003) report an average age for U.S. IPO firms of 13.3 years (median 7 years) for the years 1996-2000.

Initial returns are again heavily right skewed. The average first-day return amounts to 44.47% and peaks at a stunning 444.44% for Biodata Information Technology in February 2000, the peak of

[6] To make our figures comparable to the ones reported by Ljungsqvist (1997) we use the sample which excluded the unregulated 'Freiverkehr'

[7] The conversion rate for DM in € is 1.95583.

the IPO boom. The annual average return fluctuates quite substantially with 64.10% in 1998 and 5.32% in 2001. This suggests that the different degrees of underpricing reported for markets around the world depend importantly on the time period concerned. Erhardt and Stehle (1999) report for 1960-1995 only moderate underpricing of 15.79% with a sample maximum of 200%. During our sample period 15 firms have an excess initial return of more than 200% and 65 new issues gain more than 100%. The first-day closing price was below the offer price for 65 new issues representing 15.85% of the sample. This result is above the 8.7% reported by Wasserfallen and Wittleder (1994) for the 1961-1987 period and slightly exceeds the 15% given by Hansson and Ljungqvist (1992) for the years 1978-1991.

To get a first idea about the degree of investor sentiment prevailing during the sample period we look at the price revision series which is measured as the percentage change in the expected offer price during the bookbuilding range. This figure is assumed to reflect the information acquired from investors during the information process (Hanley, Kumar and Seguin, 1993; Ljungqvist and Wilhelm, 2003). The mean adjustment amounts to an increase of 3.92 percent with a median of 6.98%. It is rather interesting that during 1998 until early 2000, which can be considered as the period of the dot-com boom, the price revision is highest and that the acquired information leads in 2001 and late 2000 to a reduction of the expected offer price. Possible price revisions are obviously influenced by the width of the bookbuilding range as this sets the upper and lower limit for the adjustment. Again, it can be seen from Table II that during periods of high underpricing and therefore high price revision, the width of the bookbuilding range is rather low. Ljungqvist and Wilhelm (2003) find an average price revision of 5.8% which peaks at 18.7% in 1999. This relatively high figure is probably due to the fact that in the U.S. the initial price range can be adjusted upwards during the offer period, leading to a potentially higher price revision. Simple comparisons of U.S. and German figures are not easy to make. Bookbuilding days, reflecting the

subscription period, are lowest during periods of high first-day returns. This time series shows a negative trend at the beginning of the sample and is increasing as the return on the stock market index is decreasing which indicates a cool down of the investor sentiment after the bubble. The idea that investor sentiment drives IPOs first-day returns is supported by the buy and hold return of the Nemax All Share Index which represents all stocks traded on the 'Neuer Markt', as this return series is highest when underpricing peaks.

The sample period was dominated by the IPO boom and high levels of public interest in the 'New Economy' and the stock market segment 'Neuer Markt'. Table III shows some descriptive statistics to provide a closer look at different industry groups and stock market segments.

Please insert Table III around here

From Table III it is apparent that software represents, with 147 firms, the majority of the Initial Public Offerings during the sample period and that software combined with technology, the two biggest industry groups, represent 55.37 % of all IPOs. We group media (49 firms), pharma&health (35 firms), software (147 firms), technology (80 firms), and telecommunications (19 firms), which represent 80.49% of the total sample, together to form the 'New Economy'. It is interesting to note that IPOs belonging to this group yield the highest underpricing but also the highest number of negative first-day returns.

Brainpower N.V., belonging to the software group, went public in September 2000 and yielded a initial return of -30.00% whilst LS Telecom AG, belonging to the telecommunications group yield a first-day return of -28.40%. The highest positive initial returns were reported for Biodata Information Technology AG, in the technology group and Drillisch AG, in the telecommunications

group, yielded 444.44% and 403.50%, respectively. It is also interesting to note that the software group includes the IPOs with the highest initial return but also many firms with zero or negative first-day returns. Of the 'New Economy' group 188 IPOs yielded a zero or negative first-day return, representing 45.85 % of the sample. Out of these IPOs 51 yielded a negative return, representing 12% of the sample. These results support the observation of Schultz (2003) who finds that firms which are relatively unprofitable use periods of good investor sentiment and high first-day return to go public.

Ritter (1984) was among the first who showed that the 'hot issue' market is due to an increased issue activity of some industries. Inspecting Table II it becomes obvious that the German hot-issue market is mainly represented by the software and technology group, representing 55.37 % of the total sample. The industry groups media, pharma&health, software, technology and telecommunications cover 330 firms and therefore 80.49 % of our sample.

These descriptive statistics show that our sample is quite different from German samples covering earlier periods but has a quite similar structure to studies for the U.S. also covering the dot-com boom.

4.2 Underpricing of industry groups and market segments

In order to get a better grasp of our sample we have a closer look at the different industry groups as well as the different stock market segments as described in section 3.1. This can be done in our data as our sample covers all stock market segments unlike most studies of the German stock market over this time period.

Loughran and Ritter (2002) report that internet and technology stocks show higher mean first-day returns. Ljungqvist and Wilhelm (2003) find a significant and positive influence of internet and

high-tech companies, which they labeled 'New Economy', on the degree of underpricing. Lowry and Schwert (2002) find that the 'high tech' industry is dominated by higher underpricing. As there is no consensus in the literature on the membership of particular groups in the 'New Economy' segment we merge firms in the sectors that have attracted most media and investor attention. The dummy variable *new economy* includes the industry groups media, pharma&health, software, technology and telecommunications.

We run different regressions for initial returns using dummy variables for the industry classifications and the vertical stock market segmentation as regressors and present the results in Table IV.

Please insert Table IV around here

Throughout our regressions the dependent variable *initial return* is defined as $ln(P_t/P_{offer})$, where P_t represents the first-day closing price and P_{offer} the offering price, respectively.[8]

Surprisingly, none of the industry dummies are significant in regression (1). Only the coefficients on the dummy variables for transportation&logistics and finance are close to the 10% significance level. Using only industry groups belonging to the 'New Economy' as explanatory variables in regression (2) shows that only media, software and technology yield a significant and

[8] There is a controversy over whether first-day returns should be adjusted for market movement or not. Erhardt and Stehle (1999) point out that it does not make a big difference if the initial return is adjusted for the market movement or not. Loughran and Ritter (2002) show that the average market return was 0.05% per day in the U.S. market. In our sample the average return of the Nemax All Share index, calculated as the arithmetic mean, was 0.098% per day. Given this result, both methods seem to be adequate, if the correct benchmark has been chosen. As we also analyze the potential impact of price support, adjusting the raw returns for market movements would introduce a bias into our analysis. Thus, we use raw initial returns as in nearly all recent studies.

positive coefficient. On the other hand pharma, representing mainly biotechnology companies, and the industry group telecommunications are not significant. Given these results, one could argue that the C-DAX classification, used by the Frankfurt Stock Exchange, was not very accurate for these types of new firms during this time period. Taking this possibility into account we group the 'New Economy' to create one single dummy which then yields a significant coefficient.

Examining the impact of the different market segments in regression (3) shows that a listing on the 'Neuer Markt' increases underpricing by 14.2%. This result supports the hypothesis, outlined above, that initial returns are driven by investor sentiment and strong demand for new issues, as this stock market segment had been closely watched by investors and media. This strong interest led to many oversubscribed[9] issues in 1999 and 2000. The findings of Merton (1987) support this argument as he shows that investors are only able to monitor a limited number of stocks.

4.3 Cross section regression

In this section we examine the explanatory power of ex-ante uncertainty, due to asymmetrically distributed information, and investor sentiment for the underpricing phenomenon. So we try to differentiate between the effects of risk and demand on the pricing of IPOs and therefore on the initial return. To round up our analysis, we control for the possible impact of price support on our regressions. We use additional variables to make our results comparable to previous studies of the German IPO market.

Regression (7) is intended solely to assess the impact of ex-ante uncertainty. Regressions (8) to (9) measure the influence of the hot-issue market and therefore the effect of investor sentiment.

[9] Examples for oversubscribed issues: Deutsche Börse AG (23-times), Dr. Hönle AG (2-times), Infineon (33-times), OnVista AG (80-times), Pgam Advanced Technologies AG (13-Times), PopNet Internet AG (70-times), Sunways AG (33-times), T-online (4,4-times),and Winter AG (14-times).

Regressions (10) and (11) combine both groups of variables to give an overall comparison of the strength of the two approaches. The range of regressions has been chosen to give an impression of the robustness of the models concerned.

Regression (14) and (15) analyzes the explanatory power of the underwriters. Due to the fact that pre-IPO trading prices were only available for 354 firms and to document the correlation between the regressor *grey market* and the other variables *bbd* and *bbw* we re-run both regression excluding the variable *grey market*. In these regressions results we control for the effect of the 'New Economy' in regressions (18) and (19) and for the effect of the stock market segment 'Neuer Markt' in regressions (20) and (21)

These regressions allow us to check the robustness of our results. Finally, regressions (22) and (23) are presented to assess the impact of *sd* (i.e. the standard deviation of aftermarket closing prices divided by the issue price) on the models concerned. This variable has been used quite often to control for risk and uncertainty but seems to lack, as outlined below, exogeneity (e.g. Ljungqvist, 1997).

In modeling initial returns the possible existence of aftermarket price support will have an important impact on the choice of estimation method as price support by underwriters could lead to a shift of negative observations, which would then lead to a truncation of the left hand side of the distribution of initial returns. Using Ordinary Least Squares (OLS) in the presence of a censored dependent variable could lead to biased and inconsistent parameter estimates as the error term would not have a zero mean. Therefore we estimate Tobit-regressions in section 4.3.3 in addition to standard OLS estimates.

4.3.1 Ex-ante uncertainty

First, we try to analyze the explanatory power of ex-ante uncertainty which leads to a discount due to informational asymmetries. In order to accomplish this goal we run regression (7) which includes the variables *age*, *invmarketcap*, *bbd* and *bbw*.

Given our theoretical explanations and the earlier results it is not surprising that only *age* has the sign which would have been expected according to Rock's (1986) theory. *Age* is significant at the one percent level and yields a negative coefficient, which suggests that the true market value of older companies can be better evaluated than for younger firms. This result is in favor of the ex-ante uncertainty hypothesis. Wasserfallen and Wittleder (1994) report a negative and insignificant relationship between underpricing and the age of the company for Germany for the years 1961 to 1987. Supporting our results Ljungqvist and Wilhelm (2003) find a significant and negative relationship for the U.S. for 1996 to 2000. It should be noted that given our results from regressions (1) to (6) another explanation is possible and should be not ignored. In our sample many firms from the 'New Economy' went public. These firms are characterized by a short operating history and additionally by strong interest and demand during our period which was characterized by excessive media attention. Therefore, the negative sign of the variable *age* can be explained by a 'New Economy' effect and therefore re-interpreted in our dot-com sample as strong interest for firms with short operating histories. All this leads to the result that older firms experience lower initial returns as most investors are interested in 'New Economy' firms.

Invmarketcap has a positive impact as would be expected given the argument that the initial return is mainly driven by investor sentiment but lacks significance at conventional levels. Ljungqvist (1997) on the other side found a positive and significant relationship between underpricing and offer size, which is the product of offer price times issued stocks during an earlier period. As most prior IPO research does not use market capitalization but issue size as explanatory

variable the results are not directly comparable even if we expect there to be a positive correlation between market capitalization and offer size.

The negative signs of the highly significant variables *bbd* and *bbw* indicate that ex-ante uncertainty and therefore the first strand of research are not the driving force for the documented high initial returns. According to this theory an increase in ex-ante uncertainty about the 'true' market value of the IPO would lead to an increase in underpricing. As the t-statistics for these variables are above 2, the wrong sign can hardly be due to possible multicolliniarity. The negative sign of both variables leads to the conclusion that a longer subscription period or a wider indicative price range will lead to lower underpricing.

Please insert Table V around here

Jenkinson, Morrison and Wilhelm (2005) point out that contrary to the U.S., IPO information is produced, distributed and exchanged in Europe much earlier in the IPO process. Additionally, they note that analysts produce research during the pre-marketing period and therefore before the setting of the initial price range. This raises the question of how the observable sentiment of investors is incorporated in setting the subscription period and bookbuilding range for individual IPOs. In our data the average bookbuilding period and the bookbuilding range divided by it's midpoint is 6.3 days and 18.95% for firms with zero or negative first-day return and 5.7 days and 17.02% for firms with positive first-day returns, respectively. This could be interpreted as hinting that if the underwriter anticipates poor prospects for the IPO, they will increase both the period during which investors can subscribe for an IPO and the range of possible issue prices. By contrast, less uncertainty about the potential demand will be accompanied by a shorter subscription period and

indicative price range. This is backed up firstly by Kim and Ritter (1999) who show that the market value of an IPO is strongly influenced by investor demand. Secondly, by the empirical finding, that during the dot-com boom most subscriptions are closed before the official ending due to excess demand. Thirdly, by the finding that the holding period return after the first 30 trading days is still 12.79 %, whereas Hansson and Ljungqvist (1992) report a negative return for the first weeks of trading in Germany during the years 1978-1991. Fourthly, by the fact that rather surprisingly the Nemax All Share index rose on average 19.75% during the last 90 trading days prior to the IPO for successful issues and decreased by -9.11% for IPOs with zero or negative first-day return.

Summing up, one has to conclude that if, during the pre-bookbuilding period, the underwriter expects increased demand for an upcoming offering, then this will drive the setting of the indicative price range as well as of the subscription period. To support our argument we run regression (12) and (13) with the indicative price range and the subscription period as dependent variables. If investor sentiment really has an impact on theses variables the proxies should exhibit a negative sign according to the above argument.

Please insert Table VI around here

Over both regressions (i.e. regression (12) and (13)) the effects of the explanatory variables are negative and only the dummy for the 'New Economy' in the second regression is insignificant. The negative sign on *nemax* shows that an increase of stock market index 'Nemax All Share' will lead to a decrease in both the bookbuilding period and the indicative price range after having controlled for the effect of the 'New Economy'. According to our explanation, this should be due to positive sentiment reducing uncertainty about the success of the IPO. The results show, for instance, that if

the return of the ‘Nemax-All-Share’-Index rises by one percentage point the subscription period is decreased by two days. The negative sign on the dummy *new economy* leads to the conclusion that these stocks are sold more easily and therefore the subscription period can be decreased compared to other IPOs. This is contrary to the results in the earlier literature which assumes that ‘New Economy’ or internet stocks are associated with more ex-ante uncertainty as predicted by the informational asymmetries hypothesis.

4.3.2 Investor sentiment

In this section we focus on variables which are solely intended to measure the explanatory power of the investor sentiment approach and therefore the effect of demand on initial returns. To accomplish this we run regression (8) by using the variables *nemax*, *volume*, *greenshoe*, *bc* and *grey market*. Regression (10) combines both sets of variables into one model to give an overall impression of the strength of the two approaches. Additionally, regression (9) and (11) are run while excluding the explanatory power of the pre-IPO trading prices on the one hand due to the fact that this variable was only available for 354 firm and on the other hand to document the effect of pre-IPO trading prices on our models.

First, we have a close look at regression (8). The variable *nemax*, measured as buy-and-hold on the market prior to the IPO, is highly significant and quite considerable in magnitude. If, for example, the return on the ‘Nemax All Share’-Index increases by one percentage point the initial return increases by 76.1 %. There is by far no consensus about the time period to be chosen for covering this effect best. Loughran and Ritter (2002) use a three week period and Derrien (2005) uses a three month period. Our variables *nemax* covers a period of 30 days (i.e. one month). We have chosen this length of period because a shorter interval is unlikely to be long enough to allow

for a change in investor sentiment. Furthermore, a longer time period like 60 or 90 days would be too long to capture the influence on the current investment decision.

The negative and highly significant coefficient on *volume* provides evidence that the reported seasonality of issue activity substantially influences first-day returns. This is supported by Lowry (2003) who suggests that during some periods investors are overly optimistic and are willing to pay a price above the fundamental value. Again this variable covers a period of 30 days prior to the IPO.[10]

We assess the impact of the general business climate on first day returns using the business cycle variable *bc* which is also measured over the period of one month prior to the IPO. It is insignificant at standard confidence levels suggesting no effect. Measurement error in the OECD variable during the IPO boom is a possible alternative explanation. This variable was significant in the work of Ljungqvist (1997) and we find the difference in the result instructive for the dot-com period we analyze.

The impact of the dummy variable *greenshoe* is positive and significant at the 1% level. It takes the value one, if the greenshoe option has been exercised and extra shares have been issued due to excess demand. This result supports the investor sentiment hypothesis as firms who issue extra stock have higher first day returns. It is further evidence against the idea that high first day returns are a result of deliberate underpricing due to asymmetric information.

Cornelli, Goldreich and Ljungqvist (2005) note that high pre-IPO prices indicate positive investor sentiment. The variable *grey market* has an estimated coefficient of 0.197 in regression (8) meaning that in cases where the final pre-IPO trading price was above the expected offer price the

[10] Nevertheless we have used for completeness other time periods for the variables *volume* and *nemax* but did not find significantly different results. Additionally, we have also used combinations of different time periods between theses variables but found again no significantly different results to the ones reported.

initial return was on average 19.7 % higher compared to firms where grey market prices were lower during the bookbuilding period. This results again speaks for the explanatory power of the investor sentiment hypothesis as pre IPO trading closes before the setting of the offer price and therefore this information about the interest of investors towards the IPO is available to the underwriter before setting the offer price.

After combining the ex-ante uncertainty variables an the investor sentiment variables into one model only the variable *bbw*, covering the indicative price range, becomes insignificant in regression (10). This appears to be due to the inclusion of the variable *grey market.* Additional support comes from regression (9) and (11) which excludes the variable *grey market* from the regression. While analyzing the changes between regression (8) and (9) and between (10) and (11) it becomes clear that pre-IPO trading prices are influenced by the development of the Nemax All Share Index as these variables becomes more significant and stronger in magnitude whenever the variable *grey market* is not included in the model.

4.3.3 Further regressions and the effect of censored data

Regression (14) adds the variables *underwriter1* and *underwriter2*. Our proposed ranking of the underwriter is quite different to the one normally applied in the IPO research (e.g. Loughran and Ritter, 2004). But the dummy variables are insignificant and therefore have no explanatory power in our sample.

Our analysis of the effect of different industry groups on underpricing shows that firms belonging to the ‘New Economy’ have a significantly higher initial return during their initial offering. Therefore, we additionally perform regression (18) while incorporating a dummy for the *new economy* defined as above. The coefficient on *new economy* is significant at the 10 % level and a positive coefficient of 0.079 indicating that the initial returns for ‘New Economy’ firms are higher

by 7.79 %. Controlling for the effect of 'New Economy' stocks has no impact on the other explanatory variables, therefore, providing evidence of the robustness of our model.

In regressions (20) we used a dummy variable for firm going public on the German 'Neuer Markt' in order to control for the effect of different stock market segments as our sample spans all IPOs at the Frankfurt stock exchange. The positive coefficient has a p-value of 0.029 and therefore shows again that IPOs going public on the 'Neuer Markt' experience higher first day returns. This strong interest of potential investors is most likely due to extensive media coverage and very optimistic analysts' reports during the sample period. While controlling for the effect of the 'Neuer Markt' the signs of the other variables do not change nor does their significance. This speaks again for the robustness of our results. .

Wasserfallen and Wittleder (1994) use a set of variables and report that only the standard deviation of the price shows a significant effect. Therefore, to round off our analysis we incorporate this variable to document the effect of this often-used risk measure on our explanatory variables. Looking at regression (22) the variable *age* and *new economy* becomes insignificant whereas the variable *underwriter2* and *bbd* become significant. *Sd* itself is highly significant and strong in magnitude. The adjusted R^2 jumps to 53%. Therefore, incorporating *sd* changes the results quite substantial. This effect could be due to correlation between *sd* and other explanatory variables. A further explanation is that, as Ljungqvist (1997) notes, this variable might not be exogenous in this regression and it's presence may induce simultaneity bias. It might be that price support effectively limits volatility by inducing a low bound. Additionally, it can be argued that underpricing may influence price movements in the secondary market. Given these arguments we conclude that the standard deviation should not be used as an explanatory variable in the analysis of underpricing.

As briefly outlined above, the possible existence of aftermarket price support could have an important impact on the consistency of the estimation method. If underwriters prop up those IPOs

who would fall otherwise below a certain threshold (which is normally associated to be around zero), the left hand side of the distribution would be truncated. Ruud (1993) asserts that if the left hand of the distribution was essentially identically shaped as the right hand side if price support had not happened then a Tobit mean is the appropriate measure of the mean initial return. To investigate this possibility, we use Tobit-regressions (regression (15), (17), (19), (21) and (23)). This method uses information of the observable distribution to draw inference also for the unobservable side and would avoid the potential bias and inconsistency that using OLS might be subject to. The variable which seem to be mainly influenced by this effect is the variable *age*. Additionally, the variables *bbd* and *bbw* seem to be influenced by the estimation method as well as by the variable *grey market*. Summing up we can conclude that the differences between the regression results for the two estimation methods are rather small in magnitude. Therefore, the difference between the OLS and Tobit regressions suggest that the impact of the censored data is not as big as might have been anticipated.

5 Conclusion

Previous studies often claim that underpricing is a deliberate activity either by the underwriter or the issuer. Stimulated by the observation of unusually high first-day returns during the dot-com bubble we ask the question whether underpricing during the IPO boom is driven by ex-ante uncertainty or by investor sentiment and demand. In order to shed more light on this important question we analyze a sample of 410 German IPOs which went public on the Frankfurt Stock Exchange over the period 1997 to 2001, using both OLS and censored data estimation. The concluding cross section regressions builds on an initial analysis of different industry groups as well as of stock market segments.

We find that the length of the subscription period and width of the bookbuilding range have negative effects on underpricing. Our additional analysis leads to the conclusion that whenever underwriters expect positive sentiment for the IPO they set a shorter subscription period and a narrower price range . We also show that older companies can be evaluated best leading to lower first-day returns. Measures of investor sentiment like the average issue volume, market movement. usage of the greenshoe option and pre-IPO trading prices are very significant in our results.

Summing up, we conclude that during periods characterized by the presence of highly optimistic investors, ex-ante uncertainty is not the dominant source of underpricing and that investor sentiment dominates the determination of the initial return. Therefore, in our view, it is changes in investor sentiment which are the dominant influence on the fluctuations of initial returns.

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Table I
Summary of the proposed explanatory variables

Variable	Definition	Expected sign
Ex-ante uncertainty		
age	Age (difference between the foundation of the company and the IPO) of the company going public.	-
invmarketcap	Inverse of the company's market capitalisation (total number of shares multiplied by the issue price) at the IPO.	+
bbd	Length of the subscription period (difference in days between the start and ending).	+
bbw	Width of the bookbuilding range (difference between the upper and lower bound divided by the midpoint).	+
Investor sentiment		
nemax	Buy-and-hold return of the 'Nemax-All-Share'-Index during 30 days prior to the IPO.	+
volume	Number of completed IPOs during 30 days prior to the offering (i.e. IPO cycles).	-
greenshoe	Dummy variable coded one if the Greenshoe has been used and zero otherwise.	+
bc	Business climate index from the OECD statistics during 30 days prior to the IPO.	+
grey market	dummy variable coded one if the pre-IPO trading price is above the expected offer price	+
bc	Business climate index from the OECD statistics during 30 days prior to the IPO.	+
Additional variables		
underwriter1	Underwriters are ranked by the number of accompanied IPOs as lead underwriter. The dummy variable is coded if the underwriter belongs to the highest quantile and zero otherwise.	-
underwriter2	Underwriters are ranked by the number of accompanied IPOs as lead underwriter. The dummy variable is coded if the underwriter belongs to the second quantile and zero otherwise.	+
new economy	Dummy variable coded one if the IPO belongs to the new economy and zero otherwise.	+
neuer markt	Dummy variable cded on if the IPO went public on the stock market segment 'Neuer Markt' and zero otherwise.	+
new economy	Dummy variable coded one if the IPO belongs to the new economy and zero otherwise.	+

Table II
Descriptive statistics about sample firms

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. *Issue volume* is the number of issued shares (and therefore including the exercised Greenshoe) multiplied by the issue price. *Market capitalization* is calculated by multiplying the issue price with the total amount of shares at the time of the IPO. *Age* is calculated as the time period between the foundation of the company and its issue date. If the firm has gone through mergers or restructuring prior going public, the foundation date of the oldest predecessor has been chosen. *Initial return (IR1)* is calculated as (P_t/P_{offer})-1, where P_{offer} is the offer price at the end of the bookbuilding period and P_t is the closing price of the first trading day. The expected offer price is computed as the midpoint of the indicative filing range. *Price revision* is calculated as the update between the expected offer price and the issue price in percent. *Bookbuilding days* are calculated as the difference between start and end of the subscription period. The *width of the bookbuilding range* represents the difference between the upper and lower bound divided by the midpoint. The *return of the Nemax All Share index* has been calculated as holding period returns for the different time periods, therefore as (P_t/P_{t-1})-1, where P_t represents the level of the index at the end of the period and P_{t-1} the level of the index at the beginning of the period.

		1997-2001	**1997**	**1998**	**1999**	**2000**	01/2000-07/2000	08/2000-12/000	**2001**
Number of firms		**410**	16	62	165	150	(111)	(39)	17
Missing firms		**14**	10	2	1	0	(0)	(0)	1
Issue volume in Mill. €	Mean	107.97	57.20	49.87	76.02	169.64	(153.62)	(215.22)	133.49
	Median	36.79	30.10	26.47	35.19	43.78	(49.18)	(35.10)	20.22
Market capitalisation in Mill. €	Mean	374.27	252.01	143.69	240.66	620.87	(652.73)	(530.16)	451.23
	Median	125.50	92.04	82.58	124.80	153.33	(160.00)	(134.75)	64.40
Age of the company	Mean	17.59	35.75	19.94	19.55	12.13	(11.80)	(13.05)	21.10
	Median	10.32	11.68	14.92	10.05	9.53	(9.66)	(9.40)	16.28
IR1	Mean	44.47%	38.11%	64.10%	40.89%	45.41%	(54.12%)	(20.63%)	5.32%
	Median	16.40%	19.84%	38.36%	13.73%	19.25%	(25.63%)	(5.17%)	1.43%
Price Revision	Mean	3.92%	7.01%	8.23%	3.91%	2.50%	(4.80%)	(-4.06%)	-2.06%
	Median	6.98%	8.38%	7.13%	6.90%	6.82%	(7.32%)	(-3.61%)	-3.85%
Bookbuidling days	Mean	5.87	5.69	4.92	5.69	6.35	(6.09)	(7.10)	7.06
	Median	5.00	3.50	3.00	5.00	6.00	(5.00)	(7.00)	7.00
Bookbuilding range	Mean	17.58%	17.04%	15.71%	17.21%	18.30%	(17.10%)	(21.69%)	22.18%
	Median	16.84%	17.11%	15.03%	16.22%	17.34%	(16.95%)	(18.87%)	22.61%
Return of Nemax All Share Index		114.58%	97.44%	173.86%	66.23%	-39.55%	12.32%	-45.76%	-61.39%

Table III

Underpricing by industry groups

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. Industry classification (C-DAX classification) is taken from the Frankfurt Stock Exchange web pages or where not available from OnVista, 'Börsenzeitung', and Comdirect web pages. *Initial return (IR1)* is calculated as (P_t/P_{offer})-1, where P_{offer} is the offer price at the end of the bookbuilding period and P_t is the closing price of the first trading day. *IR negative* states the number or IPOs having zero or negative first day returns. As in some groups only on firm went public the standard deviation could not be calculated and therefore 'n.a.' is stated.

	Number of IPOs	Min	Maximum	Median	Mean	Standard deviation	IR negative?
automobile	6	-0.01	0.76	0.07	0.18	0.29	1
banks	3	0.14	1.38	0.43	0.65	0.65	0
basic resources	1	0.03	0.03	0.03	0.03	n.a.	0
chemicals	2	0.01	0.71	0.36	0.36	0.49	0
construction	1	0.00	0.00	0.00	0.00	n.a.	0
consumer-cyclical	5	-0.04	0.09	0.00	0.01	0.05	2
financial services	17	-0.08	1.66	0.28	0.56	0.66	4
food & beverages	1	0.01	0.01	0.01	0.01	n.a.	0
industrial	20	-0.11	0.76	0.04	0.16	0.25	6
machinery	6	-0.08	0.16	0.00	0.01	0.08	3
media	49	-0.22	3.56	0.20	0.62	0.87	13
pharma & health	35	-0.09	2.46	0.08	0.34	0.57	8
retail	8	-0.16	1.66	0.17	0.39	0.61	2
software	147	-0.30	3.52	0.26	0.50	0.71	32
technology	80	-0.18	4.44	0.26	0.46	0.69	15
telecommunications	19	-0.28	4.04	0.27	0.51	0.94	3
transp. & logistics	9	-0.07	0.69	0.02	0.10	0.23	3
utilities	1	0.00	0.00	0.00	0.00	n.a.	0

Table IV
Industry groups and stock market segments

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. Industry classification (C-DAX classification) is taken from the Frankfurt Stock Exchange web pages or where not available from OnVista, 'Börsenzeitung', and Comdirect web pages. Initial return (*IR1*) is calculated as $\ln(P_t/P_{offer})$, where P_t is the first day closing price and P_{offer} the offer price after the bookbuilding period, respectively. The industry dummies take the value one if the firm belongs to the particular C-DAX industry classification and zero otherwise. The dummies 'Neuer Markt' (nm), SMAX (smax), and 'Amtlicher Handel' (ah) take the value one if the firm went public on this specific stock market segment, respectively, and zero otherwise. We exclude industries with less than 4 IPOs. The Models are estimated using OLS and the standard errors are adjusted for heteroskedasticity of the error term using White's (1980) methodology. The results of the t-statistics (two-sided test) are denoted in brackets. The reported F-statistic is for the significance of the proposed models. We use ***, **, and * to denote significance at the one percent, five percent and ten percent level, respectively. The Number of observations is 410.

No. of regression	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	**IR1**	**IR1**	**IR1**	**IR1**	**IR1**	**IR1**
constant	0.216 *	0.181 ***	0.181 ***	0.185 **	0.183 **	0.159
	(1.735)	(4.327)	(4.333)	(2.437)	(2.354)	(1.143)
automobile	-0.075					-0.187
	(-0.381)					(-0.945)
consumer-cyclical	-0.205					-0.127
	(-0.985)					(-0.614)
financial services	0.149					0.181
	(0.971)					(1.187)
industrial	-0.088					-0.080
	(-0.587)					(-0.540)
machinery	-0.206					-0.126
	(-1.045)					(-0.646)
media	0.151	0.187 ***				0.033
	(1.119)	(2.751)				(0.238)
pharma & health	0.011	0.046				-0.100
	(0.081)	(0.612)				(-0.703)
retail	0.045					0.034
	(0.247)					(0.186)
software	0.103	0.138 ***				-0.042
	(0.805)	(2.660)				(-0.313)
technology	0.087	0.122				-0.032
	(0.659)	(2.056) **				(-0.242)
telecommunications	0.090	0.125				-0.037
	(0.598)	(1.314)				(0.241)
transp. & logistics	-0.137					-0.157
	(-0.777)					(0.369)
new Economy			0.131 ***		0.005	
			(2.812)		(0.924)	
nm				0.145 *	0.142 *	0.208 **
				(1.853)	(1.640)	(2.295)
smax				-0.016	-0.018	0.003
				(-0.200)	(-0.213)	(0.034)
ah				-0.085	-0.084	-0.028
				(-0.988)	(-0.983)	(-0.314)
F-statistic	1.577 *	2.175 *	7.909 ***	7.728 ***	5.784 ***	2.299 ***
R^2 (adjusted)	0.017	0.014	0.016	0.048	0.045	0.045

Table V
Ex-ante uncertainty versus investor sentiment

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. Initial return (*IR1*) is calculated as $\ln(P_t/P_{offer})$, where P_t is the first day closing price and P_{offer} the offer price after the bookbuilding period. The variable a*ge* is calculated as the difference between the foundation of the company and the IPO. If the firm has gone through mergers or restructuring prior going public, the foundation date of the oldest predecessor has been chosen. The inverse of the total amount of shares at the issue date multiplied by the issue price yields the variable *marketcap.* The width of the bookbuilding range (*bbw)* represents the difference between the upper and lower bound divided by the midpoint. The variable *bbd* is calculated as the difference between the start and end of the subscription period. The variable *nemax* is calculated as the holding period return of the 'Nemax All Share'-index during the last 30 trading days prior to the IPO. The total number of IPOs 30 days prior to the issue date are used to calculate the variable *volume*. The dummy variable *greenshoe* takes the value one if the total greenshoe has been used after the IPO and zero otherwise. *Bc* is the business climate index from the OECD statistics during the last month (i.e. 30/31 days). The dummy *grey market* takes the value one if the final grey market price, calculated as the midpoint of the bid-ask-spread is above the expected offer price, calculated as the midpoint of the bookbuilding range. The Models are estimated using OLS, adjusted by White's (1980) standard errors. The results of the t-statistics (two-sided test) are denoted in brackets. The reported F-statistic stands for the significance of the proposed model. We use ***, **, and * to denote significance at the one percent, five percent and ten percent level, respectively.

No. of regression	**(7)**	**(8)**	**(9**	**(10)**	**(11)**
Estimation method	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**
Dependent variable	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**
constant	-0.270 (-0.87)	-0.463 ** (-2.13)	-0.509 ** (-2.47)	-0.468 (-1.20)	-0.603 * (-1.79)
ln(age)	-0.053 *** (-3.31)			-0.031 (-1.79)	-0.048 *** (-3.12)
ln(invmarketcap)	0.023 (1.28)			0.006 (0.32)	0.012 (0.75)
ln(bbd)	-0.111 *** (-2.74)			-0.088 *** (-2.57)	-0.089 *** (-2.72)
ln(bbw)	-0.239 *** (-3.86)			-0.070 (-1.26)	-0.106 ** (-2.07)
nemax		0.761 *** (6.08)	0.922 *** (8.32)	0.745 *** (5.92)	0.865 *** (7.74)
ln(volume)		-0.091 *** (-3.45)	-0.069 (-3.26)	-0.091 (-3.36) ***	-0.072 *** (-3.30)
greenshoe		0.204 *** (5.91)	0.223 (7.32)	0.202 *** (5.89)	0.211 *** (6.79)
bc		-0.061 (-0.36)	-0.101 (-0.62)	-0.031 (-0.17)	-0.094 (0.56)
grey market		0.197 *** (6.20)		0.158 *** (4.59)	
F-statistic	11.37 ***	51.45	37.64	29.40	26.11
R^2 (adjusted)	0.08	0.36	0.31	0.38	0.35
Sample size	410	354	409	354	409

Table VI
Influence of investor sentiment on bookbuilding range and period

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. The width of the bookbuilding range (*bbw)* represents the difference between the upper and lower bound divided by the midpoint. The variable *bbd* is calculated as the difference between the start and end of the subscription period. The variable *nemax* is calculated as the holding period return of the 'Nemax All Share'-index during the last 30 trading days prior to the IPO. The dummy variable *new economy* is coded one if the IPO belongs to the 'New Economy' and zero otherwise. The Models are estimated using OLS, adjusted by White's (1980) standard errors. The results of the t-statistics (two-sided test) are denoted in brackets. The reported F-statistic stands for the significance of the proposed model. We use ***, **, and * to denote significance at the one percent, five percent and ten percent level, respectively.

No. of regression	**(12)**	**(13)**
Estimation method	**OLS**	**OLS**
Dependent variable	**bbd**	**bbw**
constant	8.949 ***	0.235 ***
	(7.79)	13.85
nemax	-2.08 **	-0.057 ***
	(-2.07)	(3.80)
new economy	-0.815 *	-0.002
	(-1.71)	(-0.27)
F-statistic	3.92 **	7.31 ***
R^2 (adjusted)	0.02	0.03
Sample size	409	409

Table VII
Further regressions and the effect of censored data

The sample covers the 1997 – 2001 period and 410 firm. The initial public offerings were taken from the Frankfurt Stock Exchange web pages and Factbooks and always double checked with the company's prospectus, homepage or investor relations department, the IPO database of the 'Börsenzeitung' and the IPO database of OnVista AG. Initial return (*IR1*) is calculated as $\ln(P_t/P_{offer})$, where P_t is the first day closing price and P_{offer} the offer price after the bookbuilding period. The variable a*ge* is calculated as the difference between the foundation of the company and the IPO. If the firm has gone through mergers or restructuring prior going public, the foundation date of the oldest predecessor has been chosen. The inverse of the total amount of shares at the issue date multiplied by the issue price yields the variable *marketcap.* The width of the bookbuilding range (*bbw)* represents the difference between the upper and lower bound divided by the midpoint. The variable *bbd* is calculated as the difference between the start and end of the subscription period. The variable *nemax* is calculated as the holding period return of the 'Nemax All Share'-index during the last 30 trading days prior to the IPO. The total number of IPOs 30 days prior to the issue date are used to calculate the variable *volume*. The dummy variable *greenshoe* takes the value one if the total greenshoe has been used after the IPO and zero otherwise. *Bc* is the business climate index from the OECD statistics during the last month (i.e. 30/31 days). The dummy *grey market* takes the value one if the final grey market price, calculated as the midpoint of the bid-ask-spread is above the expected offer price, calculated as the midpoint of the bookbuilding range. The explanatory variables u*nderwriter1* and *underwriter2* are dummy variables based on a ranking which divides the underwriter, according the total number of accompanied IPOs, into three quantiles. The variable *underwriter1* and *underwriter2* is coded one if the underwriter belongs to the highest or second quantile, respectively, and zero otherwise. The dummy variables *new economy* and *neuer markt* are coded one if the IPO belongs to the 'New Economy' or went public on the stock market segment 'Neuer Markt', respectively and zero otherwise. *Sd* is the standard deviation of aftermarket closing prices divided by the issue price. The Models are estimated using OLS, adjusted by White's (1980) standard errors, and censored data estimation (Tobit). The results of the t-statistics (two-sided test) are denoted in brackets. The reported F-statistic stands for the significance of the proposed model. We use ***, **, and * to denote significance at the one percent, five percent and ten percent level, respectively. Pseudo R^2 has been calculated for the censored data estimations.

No. of regression	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**
Estimation method	**OLS**	**TOBIT**	**OLS**	**TOBIT**	**OLS**	**TOBIT**	**OLS**	**TOBIT**	**OLS**	**TOBIT**
Dependent variable	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**
constant	-0.441	-0.412	-0.609 *	-0.824 *	-0.531	-0.518	-0.573	-0.585	-0.031	0.163
	(-1.09)	(-0.85)	(-1.76)	(-1.86)	(-1.31)	(-1.06)	(-1.38)	(-1.20)	(-0.09)	(0.39)
ln(age)	-0.033 *	-0.053 **	-0.049 ***	-0.077 ***	-0.028	-0.048 **	-0.019	-0.038	-0.013	-0.027
	(-1.86)	(-2.24)	(-3.05)	(-3.54)	(-1.50)	(-1.99)	(-0.95)	(-1.51)	(-0.81)	(-1.29)
ln(invmarketcap)	0.006	-0.006	0.015	0.014	0.008	-0.003	0.009	-0.002	0.022	0.011
	(0.31)	(-0.24)	(0.89)	(0.62)	(0.39)	(-0.13)	(0.44)	(-0.09)	(1.35)	(0.49)
ln(bbd)	-0.092 **	-0.094 *	-0.098 ***	-0.123 ***	-0.082 **	-0.086 *	-0.077 **	-0.079	-0.060 *	-0.060
	(-2.45)	(-1.87)	(-2.76)	(-2.65)	(-2.15)	(-1.70)	(-2.03)	(-1.56)	(-1.81)	(-1.38)
ln(bbw)	-0.070	-0.062	-0.103 **	-0.138 **	-0.065	-0.058	-0.051	-0.045	-0.082 *	-0.066
	(-1.28)	(-0.83)	(-2.03)	(-1.96)	(-1.21)	(-0.78)	(-0.97)	(-0.60)	(-1.69)	(-1.04)
nemax	0.743 ***	0.789 ***	0.863 ***	0.982 ***	0.748 ***	0.798 ***	0.769 ***	0.816 ***	0.630 ***	0.619 ***
	(5.89)	(5.99)	(7.71)	(8.28)	(6.00	(6.08)	(6.17)	(6.21)	(5.90)	(5.46)

Table VII - continued

No. of regression	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
ln(volume)	-0.091 ***	-0.122 ***	-0.073 ***	-0.100 ***	-0.095 ***	-0.125 ***	-0.094 ***	-0.124 ***	-0.109 ***	-0.141 ***
	(-3.34)	(-3.77)	(-3.33)	(-3.59)	(-3.51)	(-3.87)	(-3.48)	(-3.87)	(-4.90)	(-5.06)
greenshoe	0.205 ***	0.337 ***	0.214 ***	0.348 ***	0.199 ***	0.329 ***	0.193 ***	0.320 ***	0.104 ***	0.203 ***
	(5.99)	(7.11)	(6.84)	(7.97)	(5.78)	(6.93)	(5.57)	(6.75)	(3.14)	(4.82)
bc	-0.023	0.033	-0.085	-0.003	-0.048	0.004	-0.052	0.009	-0.171	-0.097
	(-0.13)	(0.16)	(-0.50)	(-0.01)	(-0.27)	(0.02)	(-0.29)	(0.04)	(-1.11)	(-0.53)
grey market	0.160 ***	0.280 ***			0.169 ***	0.286 ***	0.159 ***	0.272 ***	0.107 ***	0.191 ***
	(4.67)	(4.39)			(4.82)	(4.50)	(4.61)	(4.29)	(3.28)	(3.46)
underwriter1	-0.025	-0.046	-0.038	-0.065	-0.025	-0.045	-0.042	-0.063	-0.049	-0.073
	(-0.53	(-0.75)	(-0.82)	(-1.11)	(-0.53)	(-0.75)	(-0.86)	(-1.04)	(-1.17)	(-1.39)
underwriter2	0.053	-0.061	-0.043	-0.056	-0.048	-0.055	-0.072	-0.084	-0.073 *	-0.088
	(-0.98)	(-0.90)	(-0.87)	(-0.88)	(-0.90)	(-0.81)	(-1.31)	(-1.24)	(-1.63)	(-1.51)
new economy					0.079 *	0.077			-0.015	-0.033
					(1.69)	(1.30)			(-0.37)	(-0.64)
neuer markt							0.111 **	0.133 **		
							(2.19)	(2.01)		
ln(sd)									0.189 ***	0.220 ***
									(8.11)	(9.95)
F-statistic	24.58		21.25		22.53		22.56		27.65	
R^2 (adjusted)/ Pseudo R^2	0.38	0.38	0.35	0.35	0.39	0.38	0.39	0.38	0.53	0.55
Sample size	354	354	409	409	354	354	354	354	354	354