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 adds some further alternative explanations to traditional theories while focusing on the importance of investor sentiment as described by Cornelli, Goldreich and Ljungqvist (2004) and the importance 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 upcoming IPO, and less by ex-ante uncertainty about the firm 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 amount of money which could have been raised in addition by the issuer if the offer price would have been set at an appropriate level.

A plethora 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 therefore due to ex-ante uncertainty. Given the empirical findings, especially the high initial returns during the dot-com boom, one generally should 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 besides other areas of research 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 for risky IPOs has no effect on setting the final offer price and therefore provide an example for the fact 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 sold too cheaply but at a price which made the IPO a success for the issuer despite underpricing. Therefore, the offer price, which is set while using information about the expected demand for the IPO, gathered during and prior to the bookbuilding process, represents some sort of upper bound in the sense of Tinic's (1988) legal liability hypothesis.

The importance of investor sentiment has been first 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 irrational investors showing strong interest towards IPOs. Due to this exuberance rational investors are willing to pay a price above their fundamental value as they are always able to sell their stock to sentiment investors. 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 (2004) find evidence for the presence of sentiment demand and its influencing power on newly listed firms, while 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 its comparables, the worse its long rung 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 is irrationally optimistic towards IPOs in the short run.

In our study we try to differentiate between the effect of investor sentiment and ex-ante uncertainty to ascertain which factor is more capable to explain the high initial returns during the dot-com boom. In order to accomplish this we do not focus on survey data about sentiment or other proxies like the holdings of large (institutional) investors, put-call ratios, trading volume or closed-end fund discounts. This is due to the controversial and ongoing debate about the effectiveness and explanatory power of 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 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, 2004). Therefore, the length of the subscription period and the width of the bookbuilding range are good indicators of how 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 the possible success and the higher is the uncertainty about potential demand. This is supported by the argument of Jenkinson, Morrison and Wilhelm (2004) who assume that ceteris paribus less available information will lead to an increase in the bookbuilding range. Another novelty makes these indicative settings very interesting 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 adjustment is implemented the underwriter has to state a new price range and new subscription period which has surely a bad aftertaste for the quality and success of the initial offering.

In the U.S. pre-IPO trading (or ‘grey’ market trading) in IPO shares is prohibited. 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. The ‘grey’ market trading is usually organized by independent brokers where the Schnigge AG has a dominant position. The pre-IPO trading market can be described as rather liquid and the quoted spreads are observable from the broker or through the media e.g. Reuters or Bloomberg which is a clear indicator for the popularity of pre-IPO trading in Germany. Due to this we are able to assess the pre-IPO valuation of predominantly small investors (for a detailed analysis see Cornelli, Goldreich and Ljungqvist, 2004). During the dot-com bubble it happened quite frequently that the closing pre-IPO trading price has been above the upper bound of the indicative price range (Dorn, 2003). Aussenegg, Pegaret and Stomper (2004) therefore note that the underwriters can gauge the market’s interest in an IPO by observing pre-IPO trading.

During the dot-com boom the European IPO market has 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 capitalisation of ‘New Economy’ stocks. After the burst of the bubble the issue activity, especially in Germany, came to a standstill. These dynamic patterns make IPO-research on the Germany stock market very interesting and instructive. But difficulties in constructing a sound empirical database have meant that examinations of the underpricing phenomenon in the German stock market are limited and therefore another goal of this article is to analyze this period thoroughly. Due to the restrictions regarding available databases one mainly has to rely on hand collected data for an empirical analysis of the German IPO market. In order to control for the possibility of an unreliable or even inconsistent database we use different and independent data sources for collecting the necessary information. Our regression universe covers

410 IPOs over the years 1997 to 2001. When including pre-IPO trading prices the analyzed sample reduces to 354 firms.

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 follows 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 410 IPOs between 1997 and 2001 uses both censored and uncensored data estimation methods and 354 IPO when incorporating pre-IPO trading prices. 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 about the German stock market. Section 4 describes the firm characteristics and presents results on industry groups' impact, market segmentation, dynamics of the IPO cycle and 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 on the research influencing 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 ex-ante uncertainty due to asymmetrically distributed information which arises from the fact that the issuer or underwriter (if there are no agency conflicts between them) is better informed than the investors. This uncertainty 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 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) develope a model

[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 underpricing signifies that the described increase in share prices between primary and secondary market are due to a discount on the offer price. Contrary, the notion initial return refers to an increase due to the impact of investors demand on the in the first day trading price

in which underwriters reward better informed investors for revealing truthfully their private information by selling the 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 besides other areas of research 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 dot-com boom as during this period nearly all investors believed in an endlessly increasing stock market and therefore holding a short or opposed position could be very costly. Cornelli, Goldreich and Ljungqvist (2004) 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 both strands of research we run several regressions in which we use the below explained variables which 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, a negative sign for the variable *age* is expected which 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. Opposed to this, we use the market capitalization at the time of the IPO to form the variable *marketcap.* We expect a positive sign as the inverse of market capitalization is taken.

Jenkinson, Morrison and Wilhelm (2004) show that the length of the bookbuilding period and the width of the bookbuilding range are set after a pre-marketing period in Europe. Therefore, the underwriter and issuer are clearly aware of the potential demand for new issues before they launch the indicative prospectus. Additionally, if the issuer or underwriter is unsure about the potential demand toward the stocks to be issued, he will increase the period in which the investors can place orders. This last argument is again supported by Jenkinson, Morrison and Wilhelm (2004) who assume that ceteris paribus less available information will lead to an increase in the bookbuilding range. Surely, 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 above argument a positive sign for 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 going public decision 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 the 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). Hence, in our sample a negative sign is expected as underpricing peaks in our sample.

Cornelli, Goldreich and Ljungqvist (2004) note that due to due to 'grey' market trading we are able to assess the pre-IPO valuation of predominantly small investors. In their detailed analysis they focus on the midpoint of the final bid-ask spread before the official start of trading. 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 use similar to Löffler, Panther and Theissen (2002) the price revision between the expected offer price, calculated as the midpoint of the indicative price range, and the midpoint of the final bid-ask spread during the pre-IPO trading as explanatory variable. We expect a positive sign for the variable *revision* as a high 'grey' market prices indicate strong interest and therefore should also positively influence the initial return. Lowry and Schwert (2002) note that it is possible that underwriters treat positive information learned during the filing period differently than they treat negative information. To follow this argument we include a variable $revision^{+}$ which equals *revision* whenever *revision* is positive and zero otherwise.

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 is expected to be positive, as a raising stock market which indicates 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). Consequently, the variable *bc* should exhibit 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. Instead of using the prestige of the underwriter we use the IPO-experience. The dummy variable measures the number of IPOs brought to the market as lead underwriter. In order to facilitate this we rank the

[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.

underwriters according to their as lead underwriter accompanied issued 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 surrounded by higher initial returns. Loughran and Ritter (2002) report 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 a positive effect on initial returns. 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 telcommunication. 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.

3. Dataset

3.1 Essential Features of the German 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 the 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, 2003).

3.2 Description of the Dataset

The dataset used 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 book-building range, subscription period or foundation year are not available for 14 IPOs. Therefore, our analysis covers mainly 410 firms. The closing prices of the 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. Contrary 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 by using professional databases. Due to this constraint, most of our data is hand collected from different sources. To insure 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 employees the companies investor relations department via email or telephone about 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 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

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

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.

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 the year 2000 into two sub periods for our this descriptive analysis because in March 2000 the 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

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

The average issue volume which has been calculated by including the exercised greenshoe amounts to € 107.97 million over the sample period and is highly skewed due to some big offerings as the median is only € 36.79 million. The smallest issue was OAR Consulting in 1998 with € 4.3 million and the largest IPOs were Deutsche Post in November 2000 with € 5,842 million, Infineon in March 2000 with € 5,379 million and T-Online in April 2000 with € 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 subperiod. These figures are much higher than earlier years. For example, Ljungqvist (1997) reports[6] for 1970-1993 a mean of DM[7] 134.7 million (i.e. € 68.87 million) and median of DM 57.2 million (i.e. € 29.25 million).

Market capitalization which gives a better feeling of the different company sizes compared to the above stated 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 living IPO boom. Especially, 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 issues 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 tends to decrease because the median of the issue volume drops rather sharply.

The average 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

[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.

Frankfurt Stock Exchange are relative recently founded firms. This is supported by 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. IPOs of 13.3 years (median 7 years) for the years 1996-2000.

The 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 the IPO boom. The annual average return fluctuates quite substantially with 64.10% in 1998 and 5.32% in 2001. Therefore, it is quite obvious that the different degrees of underpricing reported all over the world depends mainly on the reported time period.. 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 exceeds slightly the 15% stated by Hansson and Ljungqvist (1992) for the years 1978-1991.

To get a first idea about the investor sentiment prevailing during the sample period we look at the price revision which is measured as the percentage change of 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 average 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 relative high figure is 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. Thus, simply comparing U.S. and German figures leads to a biased conclusion. 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 of 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 is highest when underpricing peaks.

The sample period was dominated by the IPO boom and high public attention towards the 'New Economy' and the stock market segment 'Neuer Markt'. In order to have a closer look at different industry groups and stock market segments, Table III shows some descriptive statistics.

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's rather interesting to note that IPOs belonging to this group yield the highest underpricing but also the highest negative first-day returns.

Brainpower N.V., belonging to the software group, went public in September 2000 and yielding a initial return of -30.00% and LS Telecom AG, belonging to the telecommunications group yielding a first-day return of -28.40%. The highest initial returns were reported for Biodata Information Technology AG, technology group and Drillisch AG, telecommunications group, yielding 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. Out of the 'New Economy' 188 IPOs yield a zero or negative first-day return, representing 45.85 % of the sample. Out of these IPOs 51 yield 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 telecommications represent 330 firms and therefore 80.49 % of our sample.

The above outlined descriptive statistics show that our sample is quite different from German samples covering prior periods but quite similar to studies from the U.S. 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 is done as our

sample covers, contraire to most studies on the German stock market over this time period, all stock market segments

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 surrounded by higher underpricing. As there is by far no consensus about the belonging of a certain groups to the 'New Economy' segment we merge those firms being in the center of attraction by media and investors. Therefore the dummy variable *new economy* comprises the industry groups media, pharma&health, software, technology and telecommunications.

We run different dummy regressions using 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. There is quite a controversy 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 the

price support, adjusting the raw returns for market movements would introduce a bias into our analysis. Thus, we use raw returns which have been used by nearly all recent studies.

Surprisingly, none of the industry dummies yield a significant result in regression (1). Only transportation&logistics and finance are close to the 10% 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 positive regressor. On the other hand pharma, representing mainly biotechnology companies, and telecommunications do not yield a significant result. Due to these results one could maintain the argument that the C-DAX classification, used by the Frankfurt Stock Exchange, was not very precise at this time period. Taking this possibility into account we group the 'New Economy' to one single dummy which then yields a significant result and a highly significant F-statistic.

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 the media. This strong interest led to many oversubscribed[8] issues in 1999 and 2000. The findings of Merton (1987) support this argument as he shows that investors are only able to cover a limited amount 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. To round up our

[8] 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).

analysis, we control for the possible impact of price support on our regressions. Moreover, we use additional variables to make our results comparable to prior studies on the German IPO market.

Regression (7) is intended to assess the impact of ex-ante uncertainty. Regressions (8) and (9) measure the influence of the hot-issue market and therefore the effect of investor sentiment. Regressions (11) and (12) combine all 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. Additionally, we control for the effect of the 'New Economy' by adding the dummy *new economy* in regressions (15) and (16). This is done to present a further test for the robustness of our results. Finally, regressions (17) and (18) 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 has an important impact on the 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. 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.

To show the impact of price support, consider the following model:[9]

$$\tilde{R}_i = \beta_0 + \sum_{i=1}^{n} \beta_i x_i + \sum_{j=1}^{m} \beta_j z_j + \varepsilon_i \qquad where \;\; \varepsilon \sim N\left(0, \sigma^2\right)$$

where $\tilde{R}_i$ denotes the true underlying first-day return, x_i denotes the different proxies for the estimation of the effect of ex-ante uncertainty and investor sentiment and z_j represents other

[9] This argument follows Ruud (1993) and Mihurko (2000).

explanatory variables. Due to price support the true value of the initial return, $\tilde{R}_i$, has to be transformed into a observable random variable, R_i by:

$$R_i = \begin{cases} \tilde{R}_i & if \ R_i > 0 \\ 0 & if \ R_i \leq 0 \end{cases}$$

The true mean, $\beta_0 + E\left[\sum_{i=1}^{n} \beta_i x_i + \sum_{j=1}^{m} \beta_j z_j\right]$ which is the expectation of the true model is therefore estimated by using the observable returns R_i.

We report the results for Tobit-regressions besides the standard OLS estimates in Table V. The different estimation methods are indicated in the top of the Table.

Please insert Table V around here

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*, *marketcap*, *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. Therefore, the result speaks for the ex-ante uncertainty hypothesis. Wasserfallen and Wittleder (1994) report for Germany a negative

and insignificant relationship between underpricing and the age of the company for the years 1961-1987. Supporting our results Ljungqvist and Wilhelm (2003) find for the U.S. a significant and negative relationship for 1996 to 2000. It should be noted that given our results from regressions (1) to (6) another explanation would be possible and should be not peculated. 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 an excessive media attention. Therefore, the negative sign of the variable *age* can be explained by a 'New Economy' effect and therefore repatriated in our dot-com sample to strong interest for firms with short operating histories. All this leads to the effect that older firms experience lower initial returns as most investors are interested in 'New Economy' firms.

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 above the true market value 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.

Jenkinson, Morrison and Wilhelm (2004) point out that contraire 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 about 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 its 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 have been 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 for Germany a negative return for the first weeks of trading 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 demand for upcoming offering, expected by the underwriter, during the pre-bookbuilding period drives the setting of the indicative price range as well as of the subscription period. To support our argument we run the following simple regressions 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.

$$bbd = -2.084 - 0.815 neweconomy - 2.084 nemax$$
$$[7.79] \qquad [-1.71] \qquad [-2.07]$$

$$bbw = 0.235 - 0.002 neweconomy - 0.057 nemax$$
$$[13.85] \qquad [-0.27] \qquad [3.80]$$

T-statistics calculated by using robust standard errors are shown in brackets beneath the estimated coefficient. Over both regressions the explanatory variables show a negative sign and

only the dummy for the ‘New Economy’ in the second regression is insignificant. The negative sign of *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. This should be due to the fact that positive sentiment reduces uncertainty about the success of the IPO. For instance 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 of 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 in contrary to prior literature which assumes that ‘New Economy’ or internet stocks are underlined by more ex-ante uncertainty according the informational asymmetries hypothesis.

Marketcap has a negative impact as would be expected given the argument that the initial return is mainly driven by investor sentiment but lacks significance at conventional levels. Despite this, Ljungqvist (1997) reports a positive and significant relationship between underpricing and offer size, which is the product of offer price times issued stocks. Wasserfallen and Wittleder (1994) use the level and not the inverse of the gross proceeds, but cannot find a significant relationship between underpricing and the size of the company. As most prior IPO research does not use market capitalization but issue size as explanatory variable the results are not directly comparable even if there should be undoubtedly a positive correlation between market capitalization and offer size.

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. To accomplish this we run regression (8) by using the variables *nemax*, *volume*, *greenshoe* and *bc*. Regression (9) additionally incorporates the variables *revision* and $revision^{+}$. These variables are calculated similar to underpricing while using the expected offer price and the midpoint of the final bid-ask spread. Given this set up the other explanatory variable

should interact with the 'grey' market prices. Due to this we report a separate regression in order to analyze this effect. Additionally, we were only able to collect 'grey' market prices for 354 firms. Finally, we run (10) where the dependent variable is *revision* and the explanatory variables are similar to the ones in regression (8).

First, we have a close look at regression (8). The variable *nemax*, measured as buy-and-hold prior to the IPO, is highly significant and quite considerable in magnitude. If for example the return of the 'Nemax All Share'-Index increases by one percentage point the initial return increases by 92.2 %. 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 time range as a shorter interval does to our opinion not have the ability to cover a change in the sentiment of investors due to the documented conservatism bias. Contrary, a longer time period like 60 or 90 days would be to far away to influence the current investment decision.

The negative and highly significant coefficient on *volume* provides evidence that the reported seasonality of the issue activity influences first-day returns quite substantially. 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]

In contrast to Ljungqvist (1997), the business cycle variable *bc* covering the period of one month prior to the IPO as well is insignificant at standard confidence levels which leads either to the conclusion that business climate has no effect on the initial return. Measurement error in the OECD variable during the IPO boom is an alternative explanation. There are other variables which might

[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.

cover macroeconomic conditions better, like the Ifo-Index or the benchmark calculated by the ZEW Mannheim. But our intention was, besides providing evidence for the driving force of the unusually high intial returns during the dot-com bubble, to analyze and report differences in the German IPO market over time. Therefore, we have chosen the same benchmark as Ljungqvist (1997).

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 due to this extra shares have been issued due to excess demand. Stocks, which have been issued additionally due to strong demand for the investors clearly speak in favor of the investor sentiment hypothesis. Furthermore, it supports the idea that the high initial returns reported during the dot-com bubble are not driven by deliberate underpricing due to asymmetric information.

Regression (9) analyzes besides the above stated variables the explanatory power of pre-IPO trading, which reflects the IPO valuation of private investors two days prior to the IPO. The R^2 jumps to 78% and only *greenshoe* and *revison* are significant and have the sign excepted by the investor sentiment hypothesis. Cornelli, Goldreich and Ljungqvist (2004) note that high pre-IPO prices indicate positive investor sentiment. The variable *revision* has a mean of 48.11% and maximum of 391.30 % and therefore this result speaks again clearly for the importance of investor sentiment in order to explain the Underpricing puzzle. Opposed to Lowry and Schwert (2004) and Ljungqvist and Wilhelm (2003) we cannot find an asymmetric partial adjustment in the sense of Benveniste and Spindt (1989) as the variable $revison^+$ is insignificant.

Due to the astonishing result that the highly significant variables *nemax* and *volume* become insignificant after the inclusion of *revison* and $revison^+$ we run regression (10), where *revison* is the dependent variable. We exclude the usage of the greenshoe option from our set of investor sentiment proxies as this variable is not observable prior to the IPO. The result is quite similar to regression (8) both in terms of the sign and significance. Therefore, ‘grey’ market prices are

strongly influenced by the stock market performance and the number of new issues prior to the actual IPO. Moreover, due to the positive correlation between these variables *nemax* and *volume* become insignificant.

4.3.3 Comprised Regressions and the Effect of Censored Data

Regression (11) combines the variables used in (7) and (8) into one model and furthermore adds the variables *underwriter1* and *underwriter2*. Regression (13) incorporates supplementary the variables *revision* and *revision*$^{+}$. The adjusted R^2 of regression (11) is 35% and is well above the 21% reported by Wasserfallen and Wittleder (1994) and also exceeds the 31.2% reported by Ljungqvist (1997).

The newly incorporated dummy-variables *underwriter1* and *underwriter2* are calculated by dividing the underwriters, according to the total number of accompanied IPOs as lead underwriter, into three quantiles. The dummies *underwriter1* and *underwriter2* take the value one if the underwriter belongs to the highest or second quantile, respectively and zero otherwise. Therefore, the construction is quite different to the normally proposed ranking of underwriters by their reputation (Loughran and Ritter, 2004). Our construction allows us to analyze the influence power of those underwriters on the initial return who have been engaged most to accompany IPOs. Interesting is especially the question if underwriters with more experience are able to set the offer price higher and therefore reducing underpricing for the issuer. Unfortunately, the variables are insignificant at the conventional levels and therefore no further conclusion can be drawn from the results. Alternatively, we group the underwriters into three quantiles using the study of Gerke et. al. (2001) who report a ranking of the underwriter, which is based among other criteria on the market share of the underwriter, separately for the years 1999 and 2000. We combine both years to group our underwriters and use two dummy variables analog to the above described procedure for our

regression. The dummy coded one if the underwriter belongs to the highest quantile yields a negative sign and is significant at the 5% level. The second dummy, covering the effect of the second quantile, is insignificant. Therefore, showing that higher prestigious underwriter are able to assert a higher offering price leading to lower underpricing. The result is not reported in Table VII in order to preserve space.

As briefly outlined above, the possible existence of aftermarket price support could have an important impact on the consistency of the estimation method. It is assumed that underwriters pop up those IPOs who would fall otherwise below a certain threshold which is normally associated to be around zero. Therefore, the left hand side of the distribution is supposed to be truncated due to these price support activities. Ruud (1993) assumes that the left hand would be nearly identically shaped as the right hand side if price support would have not happened and therefore calculated a Tobit mean. Consequently, we use Tobit-regressions (regression (12) and (14)) as censored data estimations use the information of the observable distribution to draw inference also from the unobservable side. Using OLS in the presence of a censored dependent variable could lead to biased and inconsistent parameter estimates. The differences between the results for the two estimation methods in the regressions are rather small in magnitude, the coefficients change only slightly as does the level of significance. Therefore, the difference between the OLS and Tobit regressions suggest that the effect of the censored data is not as big as might be anticipated.

4.3.4 Robustness Tests and the Effect of Aftermarket Standard Deviation

Our above performed 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 (15) incorporating a dummy for the *new economy* stocks which takes the value one if the IPO belongs to the ‘New Economy’ and zero

otherwise. There is no consensus in the literature which firms belong to ‘New Economy’ and which not. We combine media, pharma&health, software, technology and telecommunications to form ‘New Economy’ industry group, as these sectors have been in the center of attention in Germany during our examined timer period. The variable *new economy* has a p-value of 0.053 and a positive coefficient of 0.077 indicating that the initial return for ‘New Economy’ firms increases by 7.7%.. Controlling for the effect of ‘New Economy’ stocks has no impact on the other explanatory variables, therefore, given evidence of the robustness of our model. Besides this we have additionally used a dummy variable for IPOs 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. This dummy is coded one if the stocks have been issued on this stock market segment and zero otherwise. The positive variable is significant at the one percent level 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 excessive media coverage and very optimistic analysts’ reports during the sample period. Again, the sings of the other variables do not change nor does their significance. This speaks again for the robustness of our results. To preserve space we have not reported these results in Table V.

Besides this robustness test, we have spitted our cross-section analysis into several regressions in order to control for serial correlation between the variables. The reported results do only change slightly between the different models and therefore this is a clear and strong indicator for the robustness of our results.

Wasserfallen and Wittleder (1994) use a set of variables and reported that only standard deviation 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 (17) the variable *age* and *new economy* becomes insignificant whereas the

variables *marketcap, underwriter1 and underwriter2* become significant. *Sd* itself is highly significant and strong in magnitude. The adjusted R^2 jumps to 41%. The RESET-test had to be rejected for one and two fitted values at the one percent level. Therefore, incorporating *sd* changes the results quite substantial. This effect could be due to serious correlation between *sd* and other explanatory variables. Ljungqvist (1997) notes that this variable might induce simultaneity bias due to failure of strict exogenity. This is due to the fact that price support effectively limits volatility by inducing a low bound. Additionally, it can be argued that standard deviation might be jointly endogenous due to the fact that underpricing could influences the price movements in the secondary market. Given the above outlined argument, we have to conclude that the standard deviation should not be used as an explanatory variable in the analysis of underpricing.

5. Conclusion

Previous studies often claim that underpricing is a deliberate activity either by the underwriter or the issuer. Stimulated by 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 variables *bbd* (length of the subscription period) and *bbw* (width of the bookbuilding range) have negative effects on underpricing. This leads to the conclusion that underwriters as they are setting the subscription periods and the price ranges prior the bookbuilding period expect higher demand and, therefore, less uncertainty about the true market value of the

upcoming IPOs characterised by high initial returns. We also show that older companies can be evaluated best leading to lower first-day returns. Variables focusing on the investor sentiment hypothesis, like the average issue volume, market movement and usage of the greenshoe show very significant results. We conclude that during periods characterized by the presence of highly optimistic investors, ex-ante uncertainty is not the dominating source for underpricing and that investor sentiment dominates the determination of the initial return. Therefore, to our point of view, the change in investor sentiment influences the fluctuations of initial returns and also explains the impact of highly optimistic or even greedy investors on high 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.	-
marketcap	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.	+
revision	Difference between the midpoint of the final bid-ask spread of the pre-IPO trading and the midpoint of the indicative price range.	
revision^{+}	revision+ equals the above described variable revision whenever revision is positive and zero otherwise.	
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.	+

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
OLS industry and stock market segment regression

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
OLS-and Tobit-regressions of underpricing

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 variable *revision* is calculated as the difference between the midpoint of the final bid-ask spread during the pre-IPO trading the the midpoint of the indicative price range. The variable $revision^+$ equals *revison* if *revision* is positive and zero otherwise. 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 variable *new economy* is coded one if the IPO belongs to the 'New Economy' 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	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Estimation method	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**Tobit**	**OLS**	**Tobit**	**OLS**	**OLS**	**OLS**	**OLS**
Dependent variable	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(revision)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ir1)**	**ln(ír1)**
constant	-0.270	-0.509 ***	-0.051	-1.053 **	-0.601 *	-0.824 *	-0.293	0.173	-0.673 **	-0.303	-0.149	0.106
	(-0.87)	(-2.47)	(-0.39)	(-2.29)	(-1.76)	(-1.86)	(-1.26)	(-0.61)	(-1.93)	(-1.41)	(-0.48)	(-0.46)
ln(age)	-0.053 ***				-0.049 ***	-0.077 ***	0.000	-0.009	-0.042 ***	0.001	-0.012	0.004
	(-3.31)				(-3.05)	(-3.54)	(0.01)	(-0.62)	(-2.53)	(0.04)	(-0.81)	(0.41)
ln(marketcap)	0.023				0.015	0.014	0.015	-0.026 *	0.016	-0.015	0.027 **	-0.008
	(1.28)				(0.89)	(0.62)	(-1.36)	(-1.83)	(0.95)	(-1.35)	(1.9)	(-0.78)
ln(bbd)	-0.111 ***				-0.098 ***	-0.123 ***	-0.039 *	-0.038	-0.092 ***	-0.038 **	-0.058 **	-0.032
	(-2.74)				(-2.76)	(-2.65)	(-1.66)	(-1.31)	(-2.59)	(-1.58)	(-1.92)	(-1.39)
ln(bbw)	-0.239 ***				-0.103 **	-0.138 **	0.062 *	-0.057	-0.103 **	0.062 **	-0.081 **	-0.065 **
	(-3.86)				(-2.03)	(-1.94)	(-1.89)	(-1.33)	(-2.04)	(-1.86)	(-1.78)	(-1.97)
nemax		0.922 ***	0.054	2.085 ***	0.863 ***	0.982 ***	0.027	0.011	0.866 ***	0.028	0.695 ***	0.046
		(8.32)	(0.67)	(8.72)	(7.71)	(8.28)	(0.33)	(0.14)	(7.89)	(0.35)	(7.42)	(0.59)

Table V - continued

No. of regression	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
ln(volume)		-0.069 ***	-0.013	-0.160 ***	-0.073 ***	-0.100 ***	-0.011	-0.233	-0.079 **	-0.011	-0.089 ***	-0.025 *
		(-3.26)	(-0.87)	(-2.97)	(-3.33)	(-3.59)	(-0.70)	(-1.24)	(-3.62)	(-0.73)	(-4.87)	(-1.72)
greenshoe		0.224 ***	0.120 ***		0.214 ***	0.348 ***	0.122 ***	0.183 ***	0.205 ***	0.121 ***	0.114 ***	0.089 ***
		(7.32)	(6.07)		(6.84)	(7.97)	(6.01)	(6.76)	(6.55)	(6.00)	(3.87)	(4.24)
bc		-0.101	0.027	-0.149	-0.084	-0.003	0.098	0.171	-0.112	0.096	-0.201	0.037
		(-0.62)	(0.27)	(-0.43)	(-0.50)	(-0.01)	(0.95)	(1.40)	(-0.66)	(0.92)	(-1.34)	(0.36)
revision			0.336 ***				0.260 *	0.689 **		0.268 *		0.306 *
			(2.50)				(1.86)	(2.20)		(1.88)		(1.92)
revision+			0.114				0.187	-0.227		0.178		0.096
			(0.77)				(1.25)	(-0.72)		(1.17)		(0.57)
underwriter1					-0.038	-0.065	-0.023	-0.030	-0.037	-0.023	-0.064 *	-0.033
					(-0.82)	(-1.11)	(-0.84)	(-0.88)	(-0.83)	(-0.84)	(-1.65)	(-1.21)
underwriter2					-0.043	-0.056	-0.012	-0.014	-0.042	-0.011	-0.075 *	-0.026
					(-0.87)	(-0.88)	(-0.37)	(-0.36)	(-0.85)	(-0.36)	(-0.78)	(-0.85)
new economy									0.077 **	0.009	-0.010	-0.019
									(1.95)	(0.40)	(-0.34)	(-0.79)
ln(sd)											0.189 ***	0.074 ***
											(8.57)	(5.21)
F-statistic	11.37 ***	37.64 ***	100.09 ***	39.64	21.25 ***		59.53 ***		19.97 ***	55.06 ***	17.54 ***	27.36 ***
R^2 (adjusted)/ Pseudo R^2	0.08	0.31	0.78	0.29	0.35	0.34	0.79	0.95	0.36	0.79	0.41	0.51
Sample size	410	409	354	354	409	409	354	3.54	409	354	409	354