Sticky Prices: IPO Pricing on Nasdaq and the Neuer Markt

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April 2002

First Draft: March 2001

[1]Pegaret Pichler may be contacted at (617)552-3989 or by fax at (617)552-0431. An earlier draft of this paper circulated as The First Prices in a New Market: Nasdaq vs. Neuer Markt. We thank Ekkehart Boehmer, Jim Booth, Wayne Ferson, Edie Hotchkiss, Tim Jenkinson, Ed Kane, Gunter Löffler, Jay Ritter, Kristian Rydqvist, Phil Strahan, Josef Zechner, Christine Zulehner and participants of seminars at Boston College, the University of Bergen, the University of Frankfurt, the University of Innsbruck, the University of Oxford and Gerzensee, as well as the German Finance Association Annual Meeting (2001) for their helpful comments, and Nikolay Hovhannisyan for his valuable research assistance.

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Abstract

This paper examines the IPO pricing processes of two different markets, each of which employs bookbuilding methods for marketing the IPO shares. For each market we investigate two questions: Does bookbuilding serve mainly as a method for distributing shares, or also as a means for gathering information? And, to what extent do underwriters respond in IPO pricing to any information that they obtain through bookbuilding?

We find that a direct comparison of these two markets sheds light on the bookbuilding process in each. For Nasdaq IPOs we find evidence consistent with informational rents being earned by investors for providing information during bookbuilding. On the Neuer Markt there is no such evidence. Instead, we find evidence consistent with rents being paid for information that helps underwriters to set indicative price ranges *prior to* bookbuilding. The two markets differ further in how underwriters respond to information in pricing IPOs. For the Neuer Markt, this response is severly constrained since underwriters do not set prices above the price ranges. We estimate the total cost of this "restriction " to be approximately one billion Euros for our sample of IPOs. While there are no such apparent restrictions for Nasdaq, we show that also on this market IPO prices are "sticky" in that underwriters respond less to information received later in the pricing process.

Key words: Initial public offerings; underpricing
JEL classification: G32

1 Introduction

It has been well documented in the academic literature that shares sold in initial public offerings (IPOs) are on average underpriced.[1] It has also been documented by Hanley (1993) that there is a significant positive relationship between initial returns and the revision of IPO prices from preliminary price ranges set some time before pricing.[2] This suggests that underwriters adjust IPO prices only partially in response to information learned between the time of setting the price ranges and that of pricing.

There are a number of possible explanations for this "partial adjustment phenomenon". Benveniste and Spindt (1989) argue that underpricing may occur as a result of an auction-like process in which underwriters obtain information from investors. To provide incentives for investors to truthfully reveal positive information about an issue, the underwriters only partially adjust the IPO prices to such information, and allocate underpriced shares to those investors who provide the positive information. Loughran and Ritter (2002) present an alternative theory which builds on prospect theory. They argue that underpricing is essentially a form of compensation to underwriters (in the form of quid pro quos that they receive from investors) and that issuers care less about underpricing if offer prices are revised upwards due to good news after the setting of price ranges. This theory allows for partial adjustment of offer prices to both public and private information.

Alternatively, the partial adjustment phenomenon may occur due to constraints that are imposed in "bookbuilding", i.e. the process by which underwriters collect orders from potential investors in IPO shares, and thus receive information for pricing these shares.[3] If the partial adjustment phenomenon reflects a lack of information-sensitivity of IPO prices beyond what would result merely from the need to pay investors informational rents, then this may be due to features of the bookbuilding process itself. We refer to such an effect as "price stickiness".

[1] For example, Ritter (1984), Ibbotson, Sindelar and Ritter (1988), Loughran, Ritter and Rydqvist (1994), and Loughran and Ritter (2001) all provide evidence of significant positive returns from the offer price to the first day closing price of IPOs. Such underpricing is a phenomenon that can be observed in nearly all equity markets in the world (see e.g. Loughran, Ritter, and Rydqvist (1994) and Ritter (2002)).

[2] Maksimovic and Unal (1993) also document the existence of the phenomenon for thrift conversions.

[3] There are differences across markets as to whether these orders are binding, or perhaps just "indications of interest". This is discussed further in the paper.

Even though the term bookbuilding is often used as a generic term, the details of the bookbuilding process differ across markets in ways that may affect IPO pricing. In this paper we look at two different IPO markets, the Nasdaq market in the U.S. and the Neuer Markt (New Market) in Germany, for evidence consistent with the theories described above.[4] More specifically, we will ask two questions for each market: Does bookbuilding serve mainly as a method for distributing shares, or also as a means for gathering information? And, to what extent do underwriters respond in IPO pricing to information that they obtain through bookbuilding? By addressing these questions for two markets that are quite similar, yet different in some of the details of bookbuilding, we are able to increase our understanding of why IPO offer prices may be sticky.

The Neuer Markt was created in March 1997 by the Frankfurt Stock Exchange in order to facilitate the financing of young companies. In 1999 more companies went public on the Frankfurt Stock Exchange than on the London Stock Exchange. (See Table 1.) Only Nasdaq saw more IPO activity. The Neuer Markt is similar to U.S. equity markets in its disclosure requirements for listing firms and is similar to Nasdaq in the types of firms that go public and list there.[5] Further, the Nasdaq and Neuer Markt IPO markets are similar in that investment banks in both countries employ bookbuilding methods for marketing IPOs. However, the bookbuilding process on the Neuer Markt differs from that on Nasdaq in a number of details that affect our research questions.

First, we consider the question concerning the informational role of bookbuilding. In answering this question, we search for and find in each market, evidence consistent with the theory of Benveniste and Spindt (1989), i.e. that investors receive informational rents for providing underwriters with information of relevance for IPO pricing. But, there are differences between the two markets, particularly in whether underwriters gather information mostly during bookbuilding or mostly before they start to collect investors' orders. On the Neuer Markt, bookbuilding starts after the posting of preliminary price ranges, typically one week before pricing. During this week, bookbuilding seems to be mainly a method for distributing IPO

[4]We do not assume that the theories are incompatible, but rather that they may coexist.

[5]Kukies (2000) states that firms that go public on the Neuer Markt are "small, young and belong to industries in which future growth opportunities rather than fixed assets determine market valuation".

shares: while investors post orders, we find no evidence that they earn informational rents for providing information contained in these orders. We do, however, find evidence consistent with such rents being paid for information that determines where underwriters set price ranges *prior* to bookbuilding. In contrast, for Nasdaq we find evidence consistent with an informational role of bookbuilding *after* the setting of price ranges. Indeed, underwriters seem to use bookbuilding to gather information right up to the pricing date, i.e. even in pricing IPOs relative to ranges set less than one week earlier. Thus, both the timing of information gathering and the purpose of bookbuilding appear to differ across markets.

Next, we consider the second question about how underwriters respond to information in pricing IPOs. In answering this question, the comparison of the two markets has been instrumental for molding our understanding of each market. The first thing that we note is that IPOs on the Neuer Markt are never priced above the posted preliminary price ranges. We find that this is not an insignificant restriction. For those Neuer Markt IPOs with constrained offer prices, we estimate the cost of the constraint to be on average more than sixteen million Euros left on the table per issuer. This results in a total cost of more than one billion Euros for our two-year sample of high technology IPOs!

On Nasdaq there is no such pricing restriction. In fact, half of the issues in our Nasdaq sample are priced strictly above the posted ranges. However, in our efforts to directly compare the two markets we find that there is also price stickiness in the Nasdaq IPO market. But, this price stickiness takes a different form than on the Neuer Markt: for Nasdaq IPOs, we find that the partial adjustment phenomenon is significantly stronger for IPOs that are priced relative to ranges amended shortly before pricing the IPOs. This suggests that underwriters are loathe to react to "last minute" information in pricing Nasdaq IPOs: if this information is favorable, IPO prices are revised upwards by less and, hence, more money is left on the table for investors, thus resulting in a stronger relation between the price revision and initial returns.

We believe that the explanation for price stickiness lies in the details of the bookbuilding process. On the Neuer Markt, both the underwriters and investors make "commitments" prior to the final pricing of IPOs. Investors commit to buying IPO shares since they submit binding orders during the bookbuilding period. Underwriters on their part do not price IPOs above the

price ranges that are set at the start of bookbuilding. They will, however, price IPOs below these ranges, if information learned during bookbuilding warrants doing so. In the Nasdaq IPO market, large investors do not make formal binding commitments during bookbuilding, and underwriters on their part do not commit to price IPOs within the price ranges. And yet, we find that Nasdaq underwriters appear loathe to revise IPO prices too much relative to price ranges set shortly before IPO pricing.

Our paper extends the existing literature by investigating information gathering in two markets that employ somewhat different bookbuilding processes. While we focus on IPO pricing, other papers have examined other aspects of the bookbuilding process, such as the allocation of IPO shares to investors who post orders. Cornelli and Goldreich (2001) examine bookbuilding by one European investment bank and find that investors who post more informative bids do on average earn higher profits since they receive more favorable allocations of IPO shares. Jenkinson and Jones (2001) also examine data about order books of European IPOs and find that, while some informed institutional bidders are favored in the allocation of IPO shares, this favorable treatment is not necessarily a reward for information contained in their orders. Our results for the Neuer Markt are more consistent with the latter results. Aggarwal, Prabhala and Puri (2002) investigate for U.S. IPOs the question of favorable treatment for institutional investors. They find that institutions receive higher allocations in IPOs priced above the preliminary price ranges and in IPOs with higher initial returns. These results are consistent with the model by Benveniste and Spindt (1989) and, hence, our results for Nasdaq if the institutional order flow contains more information of relevance for IPO pricing than orders of retail investors.

Further, our paper is related to empirical studies that show how initial returns reflect information that is publicly available prior to the pricing of IPOs. While we regard such effects more as something to control for in our analysis, than as the focus of our research, we confirm several recent findings. As Loughran and Ritter (2002), Bradley and Jordan (2001), Lowry and Schwert (2002), Benveniste, Ljungqvist, Wilhelm, and Yu (2002), and Ljungqvist and Wilhelm (2001), we find that initial returns are related to primary and secondary market conditions prior to IPO pricing. As in Bradley and Jordan (2001) and Boehmer and Fishe (2001), we

find that information contained in range amendments is relevant for explaining IPO pricing. Finally, we control for an effect of underwriter reputation on IPO pricing: by following Habib and Ljungqvist (2001) in treating issuers' choice of underwriters as endogenous, we confirm that underwriter reputation has no significant effect.[6]

The paper is organized as follows. The following section provides a description of institutional differences and similarities between the Nasdaq and Neuer Markt IPO markets. The third section describes our approach to examining the pricing processes of IPOs on the two markets and presents our hypotheses. In the fourth section we describe the data. The fifth section provides summary statistics and a discussion of our empirical results. The final section concludes with a brief summary of the key results from Section 5, and a discussion of these results.

2 Institutional Differences between Nasdaq and the Neuer Markt

In this section, we set the stage for the analysis of IPO pricing on Nasdaq and the Neuer Markt by comparing relevant institutional features of the two primary markets.

Listing requirements: Table 2 states criteria that issuers must satisfy for initial listing on the Neuer Markt and Nasdaq. While these criteria suggest that Neuer Markt IPOs may be smaller than Nasdaq IPOs, there are few other differences.[7] And in fact, the descriptive statistics in Table 3 indicate few differences between our samples of IPOs on the two markets. Even in terms of size, these IPOs are quite similar albeit with more variation across IPOs on the Neuer Markt than on Nasdaq.

IPO pricing through bookbuilding: In both markets, bookbuilding is the dominant method for selling IPO shares.[8] Also, underwriters on both markets post price ranges some time before the final pricing of issues. However, apart from these basic similarities, there are a number of

[6]However, we also explore the effect of underwriter reputation if treated as exogenous. Then, we obtain results that confirm the findings of a number of other studies that are cited below.

[7]In fact, the Neuer Markt even requires issuers to draw up financial statements according to US-Generally Accepted Accounting Principles (GAAP) or International Accounting Standards (IAS).

[8]This was also pointed out by Ljungqvist, Jenkinson and Wilhelm (2001) and Sherman (2001).

differences. The first of these differences concerns the duration of time between publishing the price ranges and setting the offer prices of IPOs. On the Neuer Markt, the ranges are typically posted one week prior to pricing and bookbuilding occurs during this week. On Nasdaq, there is significant variation in when price ranges are first filed with the Securities and Exchange Commission (SEC). In our sample, the earliest time that a range was first posted was 140 days before pricing; the latest was 11 days before. Also, the duration of the bookbuilding period is not formally designated on Nasdaq, while underwriters on the Neuer Markt announce in advance for how long they collect investors' orders.

Second, there are differences in underwriters' ability to amend price ranges in response to information that they obtain during bookbuilding. While such range amendments occur almost never on the Neuer Markt, it is common that underwriters update price ranges prior to the pricing of IPOs on Nasdaq. In our sample of Nasdaq IPOs with ranges in place three weeks prior to pricing, about one-third of these ranges were amended at least one day before the pricing date.

Third, IPOs on Nasdaq and the Neuer Markt differ in how underwriters set the offer prices relative to the posted price ranges. While Nasdaq issues are frequently priced outside the final price ranges, this happens very rarely at the Neuer Markt. In our sample, some Neuer Markt issues are priced below the ranges, but none are priced above. The best explanation for this phenomenon is that, during the bookbuilding period, investors place *binding* market orders with underwriters on the Neuer Markt. In conversations with an investment banker we learned that underwiters are concerned about legal problems that may ensue if they then price issues above the upper bound of the posted ranges.[9] In the United States, underwriters do not face such problems since they collect non-binding orders during bookbuilding. However, there is a legal restriction that IPOs may raise no more than 120% of the proposed maximum proceeds. While this restriction may constrain IPO pricing, we find that many IPO firms amend their ranges (and thus their proposed proceeds), possibly to avoid any such restriction, and that only seven issues in our entire Nasdaq sample are priced at exactly 120% of the maximum of the respective proposed proceeds. Thus, we do not believe that this is a binding restriction for

[9]For the same reason, underwriters do not amend the posted ranges.

most IPOs.

Pre-IPO trading: The Neuer Markt differs from Nasdaq in that there is a when-issued, forward market for IPO shares. This "pre-IPO market", also known as "Handel per Erscheinen" but more commonly called the "grey market", has grown rapidly in recent years. Grey market trading starts after the setting of the price ranges, but before the pricing of IPOs. The last grey market trading day is the day before the first exchange trading day. Several banks and brokers act as market makers, but due to conflicts of interest they do not make the market in IPOs for which they act as underwriters (see Löffler, Panther and Theissen (2001)). Bid and ask quotes are published in newspapers, the internet and by large information vendors, like Reuters or Bloomberg. All grey market transactions are contingent on whether an IPO takes place and are settled on the IPO's first trading day on the exchange. Selling IPO shares in this market is (by definition) short-selling,[10] and is restricted to institutions and large investors.[11]

3 The Hypotheses

In this section, we state hypotheses motivated by two main questions that are the focus of the empirical analysis in Section 5. The first of these questions is whether bookbuilding serves mainly as a method for distributing shares or also as a means for gathering information. The second is whether IPOs differ in the extent to which underwriters respond in IPO pricing to information that they obtain during bookbuilding. These questions take on a particular interest for comparing the primary markets of Nasdaq and the Neuer Markt which are so similar to each other, and yet differ in details (discussed above) that affect these questions. To see this, consider the first question concerning the informational role of bookbuilding. The answer to this question clearly depends on the extent to which underwriters can draw on publicly available information in order to price IPOs. This extent is likely to differ across the two markets due to the existence of an active pre-IPO trading market for IPOs only on the Neuer Markt. Next, consider the second question concerning underwriters' flexibility in

[10] As in the US, insiders who owned shares prior to the IPO are restricted in their ability to sell these shares.

[11] See the website of Schnigge, http://www.schnigge.de/index.html

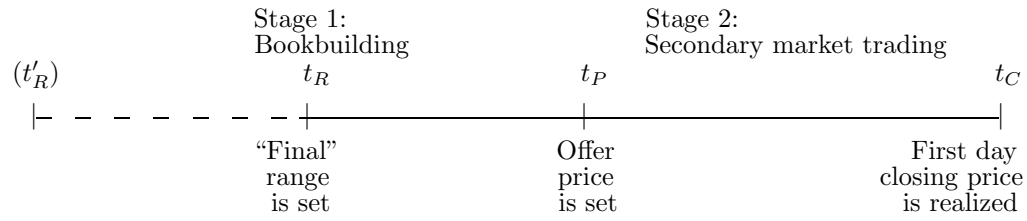

Figure 1: The IPO Pricing Process

IPO pricing. Again, it is likely that there are differences between the two markets due to the different nature of the orders that investors post during bookbuilding: after receiving binding orders, underwriters on the Neuer Markt cannot price IPOs any higher than allowed for by the posted price ranges. However, pricing IPOs above these ranges is common on Nasdaq.

To introduce the formal discussion of our research strategy in the remainder of this section, Figure 1 shows how IPO pricing can be broken into two stages: the stage of bookbuilding up to the time of setting the offer price is followed by the first day of secondary market trading. It is in the bookbuilding stage where Nasdaq differs from the Neuer Markt as discussed above. Specifically, IPOs on the Neuer Markt are priced relative to price ranges set at time t_R, typically one week before pricing at time t_P. These price ranges are "final" ranges since there are no range amendments after time t_R which marks the onset of both grey market trading and bookbuilding, i.e. the period during which underwriters collect investors' orders. Nasdaq differs from the Neuer Markt in that the final price ranges are sometimes set through amendments of ranges set "earlier", i.e. at some time $t'_R < t_R$. While we control for such range amendments in the empirical analysis in Section 5, this is not the focus of our study. Instead, the hypotheses stated below concern that part of the IPO pricing process that is most comparable across Nasdaq and the Neuer Markt, i.e. the pricing of IPOs relative to the midpoints of "final" price ranges set at time t_R. For Nasdaq IPOs we define final price ranges as those that are the current ranges one day before pricing.[12]

[12]We chose this approach over an approach of analyzing IPO pricing relative to initial ranges, because there is much variation in the time when initial ranges are set on Nasdaq, and we believe, in the information content of such ranges. This is, of course, also a potential issue with our time consistent set of "final" ranges, but we control for the variation in two ways. First, we include in the data the exact date when each "final" range was first posted, so that we can use this date to determine what market information was revealed between the first posting of that range and the setting of the offer price. Second, for ranges that are the results of amendments of ranges set earlier, we control for the earlier range (and earlier range setting date).

In the following subsections we develop hypotheses that enable us to address the two questions posed at the beginning of this section. Due to institutional differences, the exact forms of the hypotheses differ across the two markets.

3.1 The Neuer Markt

As discussed in Section 2, the offer price of an IPO on the Neuer Markt is effectively constrained by the upper bound of the price range. In this section, we propose hypotheses concerning the implications of this "pricing constraint" and other institutional features of the Neuer Markt for IPO pricing and underpricing. We focus on how the offer price of an IPO is set relative to the center of the price range set at time t_R. For an IPO on the Neuer Markt, this price revision can be expressed as follows:

$$PREV = \min[PREV^*, MAXREV], \tag{1}$$

where $PREV$ denotes the actual price revision from the range center to the offer price (in Euros), $MAXREV$ is the maximum possible price revision (i.e. the difference between the top and the center of the price range), and $PREV^*$ is the "latent" price revision that would result if the underwriter were able to set the offer price above the top of the price range. This latent price revision reflects both public information realized between time t_R and time t_P, and private information that the underwriter obtains from investors during bookbuilding:

$$PREV^* = PREV_0 + \beta \times i, \tag{2}$$

where $PREV_0$ is the latent price revision induced by public information, i is private information about the value of IPO shares that the underwriter receives through bookbuilding, and β is a coefficient that will equal one if the underwriter fully adjusts the offer price in response to the private information.

We assume that the first day closing price reveals the true share value (or, alternatively, that the information gathered by underwriters is about the first day closing price). Then, the initial return can be expressed as:

$$IR = IR_0 + \begin{cases} (1-\beta) \times i & \text{if } PREV < MAXREV, \\ (1-\beta) \times i + (PREV^* - MAXREV) & \text{if } PREV = MAXREV, \end{cases}$$

where the inital return IR is the difference between the first day closing price and the offer price of an IPO, and IR_0 is the initial return if $i = 0$ (no private information is received through bookbuilding) and if the offer price is not constrained by the top of the price range ($PREV < MAXREV$).

It remains to derive the relation between the price revision $PREV$ and the initial return IR. This relation follows from the fact that $i = (PREV^* - PREV_0)/\beta$. Upon substituting for i in the above-stated equation, we obtain the following equivalent:

$$IR = IR_0 + \begin{cases} \gamma_U \times (PREV^* - PREV_0) & \text{if } PREV < MAXREV, \\ \gamma_C \times (PREV^* - PREV_0) & \\ \qquad +\delta \times (PREV_0 - MAXREV) & \text{if } PREV = MAXREV, \end{cases} \tag{3}$$

where $\gamma_U = (1-\beta)/\beta$, $\gamma_C = 1/\beta$, and $\delta = 1$. In interpreting the above equation, $PREV^* - PREV_0$ is that part of the price revision that cannot be explained with public information; $PREV_0 - MAXREV$ is the extent to which the price range constrains the price revision if the underwriter receives no private information ($i = 0$ so that $PREV^* = PREV_0$).

In the remainder of this section, we form a number of hypotheses about IPO pricing on the Neuer Markt, discussed in detail below. Most of these hypotheses follow directly from equation (3) and fall into two categories, i.e. (i) hypotheses about the "informational role of bookbuilding" that specify absolute values of the coefficients γ_U and γ_C, and (ii) hypotheses about "price stickiness in IPO pricing" that specify the relative magnitude of these coefficients. In the discussion of these hypotheses below, we refer to IPOs priced at the top of their price ranges as "constrained" IPOs.

Informational role of bookbuilding: The first hypothesis concerns the nature of bookbuilding: whether it is just a method for distributing shares, or is also used for gathering pricing-relevant information. According to the above-stated equations, the values of the coefficients γ_U and γ_C should capture any relation between initial returns and such pricing-relevant information. In our empirical tests of equation (3), we will test the hypotheses stated below that specify the values of γ_U and γ_C if $\beta = 1$. Rejecting that $\beta = 1$ is consistent with an informational role of bookbuilding since investors can earn informational rents of $(1-\beta) \times i$ by posting informative

orders and, hence, they post such orders. By substituting for $\beta = 1$ in the definitions of γ_U and γ_C stated below condition (3) we obtain the following null hypotheses:

INFO$_\mathbf{U}$: The coefficient γ_U is equal to zero.

INFO$_\mathbf{C}$: The coefficient γ_C is equal to one.

The alternative hypotheses follow from the theory of Benveniste and Spindt (1989): to obtain private information through bookbuilding, underwriters only partially adjust the offer price with respect to positive information, i.e. $\beta < 1$. In this way, investors receive informational rents in the form of initial returns. Thus, the alternative hypotheses are: $\gamma_U > 0$ and $\gamma_C > 1$.

We also test a related hypothesis concerning the grey market as a source of information for IPO pricing. Specifically, we may fail to find evidence of an informational role of bookbuilding since pre-IPO trading in the grey market may generate sufficient information to price IPOs on the Neuer Markt. As grey market trading information is publicly available, there should be no need to pay rents for information that emanates from this market. Underwriters should fully adjust the offer prices of IPOs to information contained in grey market prices. Thus, the following null hypothesis:

GREY: The price revision $PREV^*$ is associated with a coefficient of one with the difference between the last grey market price before time t_P and the center of the price range set at time t_R.

In the remainder of the paper we refer to this difference between the last grey market price before time t_P and the center of the price range as the "grey market return". The alternative hypothesis follows from the possibility that underwriters need information to set price ranges prior to the start of grey market trading. While we expect that grey market prices publicly reveal this information, such revelation does not occur until *after* the setting of the range. Thus, investors may earn informational rents for providing this information *prior* to range setting. As a result, underwriters may cede rents to investors for information that is subsequently contained in the grey market prices. This leads to a partial adjustment of IPO prices to grey market prices. Consequently, the alternative to hypothesis **GREY** is that the

coefficient of the grey market return is less than one.

Price stickiness in IPO pricing: Equation (3) also provides predictions as to how initial returns are related to the underwriters' inability to price above the range. According to this equation, there are two basic effects. First, initial returns should be directly related to the extent by which IPO prices are constrained. In equation (3), the term $PREV_0 - MAXREV$ measures the extent to which price ranges constrain the price revision induced by public information realized between time t_R and t_P. We thus have the following null hypothesis:

DELTA: The coefficient δ equals one.

A further implication of equation (3) is that the coefficient γ_C should be greater than γ_U. Under the assumption (implicit in our derivation) that bookbuilding generates information i with the same distribution across the two sets of IPOs, this difference should equal one. However, this assumption may be violated. To see this, note that an underwriter's demand for information should be related to his ability to incorporate the information into IPO prices. On the supply side, investors' incentives to provide information during bookbuilding may also be affected by the underwriter's ability to adjust offer prices in response to the information. In terms of equation (3), this implies that the coefficients γ_C and γ_U may differ by more or less than one. To test for such an effect of price stickiness in IPO pricing, we specify the following null hypothesis:

$\mathbf{STICKY_{NM}}$: $\gamma_C - \gamma_U = 1$

3.2 Nasdaq

On Nasdaq, underwriters can price IPOs above the posted price ranges. As a consequence, the actual price revision $PREV$ equals the latent price revision $PREV^*$ for all IPOs. Moreover, initial returns of Nasdaq IPOs should be related to $PREV$ $(= PREV^*)$, as in the first line of equation (3).

Informational role of bookbuilding: As for the Neuer Markt, we also test for Nasdaq whether there is a systematic relation between the pricing and the initial returns of IPOs. Thereby,

we distinguish between IPOs with final price ranges set more, or less, than one week before pricing, i.e. "early" (E) or "late" (L) respectively:

$$IR = IR_0 + \begin{cases} \gamma_L \times (PREV - PREV_0) & \text{if } t_P - t_R \leq 7 \text{ days}, \\ \gamma_E \times (PREV - PREV_0) & \text{if } t_P - t_R > 7 \text{ days}, \end{cases} \tag{4}$$

We draw this distinction in order to control for the possibility that the nature of bookbuilding may change over time. In particular, we want to allow for the possibility that bookbuilding may serve mainly as a method for distributing IPO shares after range amendments that happen shortly before pricing.[13] Analogous to the hypothesis $\mathbf{INFO_U}$ for the Neuer Markt, we thus have the following hypotheses:

$\mathbf{INFO_L}$: The coefficient γ_L equals zero.

$\mathbf{INFO_E}$: The coefficient γ_E equals zero.

The alternatives are that each coefficient is greater than zero, consistent with an informational role of bookbuilding as modelled by Benveniste and Spindt (1989).

Price stickiness in IPO pricing: As for the Neuer Markt, we investigate also for Nasdaq whether there are differences across IPOs in how underwriters price issues in response to any information that they obtain during bookbuilding. For the two subsamples of IPOs defined above, such differences may indicate that underwriters are loathe to react to "last minute" information that they obtain after range amendments shortly before pricing. To check for this form of price stickiness, we put forward the following null hypothesis:

$\mathbf{STICKY_{NQ}}$: The difference $\gamma_L - \gamma_E$ is equal to zero.

4 Data

We have collected data for all internet services, internet software and computer software IPOs that began trading on Nasdaq or on the Neuer Markt between January 1999 and December 2000. As Table 1 indicates, 1999 was the first year in which the Neuer Markt experienced a significant IPO volume. (In 2001 only 11 IPOs took place on the Neuer Markt.) The three

[13] In the econometric model we also allow for different values of IR_0 for the two subsets of issuers.

industries that we study account for close to one-half of the IPO volume in each market during 1999 and 2000.[14] By focussing only on these three industries we are able to conduct more of a controlled experiment since we compare IPOs that are somewhat similar.[15]

All of the IPOs in our data set are firm commitment offerings. Because of our focus on the information content of the preliminary price range, we exclude IPOs for which there was no price range, but only a single suggested price. From the sample of Neuer Markt IPOs, we further exclude issues that had been listed at another exchange prior to listing at the Neuer Markt. This results in a sample of 326 Nasdaq IPOs and 117 Neuer Markt IPOs.

Most of the data describing the Nasdaq IPOs were obtained directly from the U.S. Securities and Exchange Commission's (SEC) Edgar database. For secondary market trading data, we draw on CRSP and Reuters as data sources. Industry definitions for Nasdaq firms were obtained from IPO.com, but were cross-checked with the business descriptions.[16] Data for the Neuer Markt IPOs was obtained from Deutsche Börse AG (prospectuses, price ranges, and other primary market information), and Reuters, Datastream and Karlsruher Kapitalmarktdatenbank (secondary market information) as well as from one of the two most important market makers in the grey market, the German Schnigge AG (grey market prices). For each IPO, we know the last grey-market trading price before the date of pricing the IPO. Unfortunately, this information is not available for 10 IPOs, leaving us with a sample of 107 IPOs for some of the regressions below.[17]

A data set of Nasdaq price ranges and final offer prices was constructed by searching all the SEC filings prior to the offer date, starting with an S-1 (or SB-2) filing for the initial IPO statements, followed by amendments in the form of S-1A (or SB-2A) filings and the final prospectus (424B filing). After searching through more than 2,600 SEC filings, we created a data set that includes for each IPO the first filed range and all range amendments, together

[14] After applying a number of exclusions, described below, the three industries account for 45.5% of all nonfinancial IPOs on the Neuer Markt and 49.9% on Nasdaq.

[15] Our empirical analysis confirms that industry focus is important. For example, we find that there are cross-market influences between the Nasdaq and Neuer Markt IPO markets, but only when we check for such influences by industry. We did consider including a wider range of industries in the study, but found that in all other industry categories the Neuer Markt data was too sparse.

[16] In doing this check, we found that many of the firms in our data set really belong to two, or all three, of our industry categories. For this reason we treat these three indutries as one industry.

[17] This lack of data seems to be due to Schnigge's recent move to new premises.

with the dates on which all ranges were filed, and the final offer price and offer date. We also obtained from these filings information on the proposed number of shares to be sold, the number of shares outstanding and total assets at each range-posting date and the offer date. This data set enables us to construct sets of "time consistent" ranges for any specified time period before the IPOs. For example, as described in Section 3, our set of "final" ranges includes only ranges that were in effect exactly one day before pricing each IPO.

Table 3 provides some descriptive statistics. The mean firm sizes and issue sizes are quite similar between the two markets for our industries. However, the median firm size on the Neuer Markt is less than half of the median size on Nasdaq and the Neuer Markt median issue size is less than two-thirds of the median issue size on Nasdaq.[18] We find that firms listing on the Neuer Markt sell, on average, a somewhat larger fraction of their firm at the IPO than do firms listing on Nasdaq.

5 Empirical Analysis

In our analysis of IPO pricing on Nasdaq and the Neuer Markt, we focus on that part of the pricing process that is most comparable across markets, i.e. how underwriters price IPOs relative to the final price ranges that are in place one day before the pricing date.[19] In Section 5.1, we present summary statistics describing these ranges, IPO pricing, and initial returns. In Sections 5.2 and 5.3 we analyse IPO pricing and underpricing as outlined in Section 3.

5.1 Descriptive Statistics

Table 4 provides descriptive statistics for the final price ranges of IPOs on Nasdaq and the Neuer Markt (Panel A) and the pricing of IPOs relative to these ranges (Panel B). For Nasdaq we present statistics for our total sample of IPOs and two subsamples, distinguishing between

[18] For Nasdaq IPOs the currency is US$, for Neuer Markt IPOs all currency amounts are in Euros. As we do not run any regressions with both Nasdaq and Neuer Markt IPOs we do not convert any of the currencies. During the two years of our study the value of the Euro ranged from $0.836/Euro to $1.216/Euro. The average value of one Euro during this time period was $1.012.

[19] As discussed in Section 3, these price ranges are the only price ranges for IPOs on the Neuer Markt. For a number of Nasdaq IPOs these"final" ranges are amended further on the pricing day. We do not include these range amendments in our analysis since it is unlikely that any revision of IPO prices from the revised ranges is due to information that underwriters obtain after setting the ranges.

IPOs with final price ranges set "early" or "late", i.e. more or less than one week before pricing. Comparing across markets reveals several differences. As discussed below, these differences suggest that price ranges are set more deliberately on the Neuer Markt than on Nasdaq. This is intuitively appealing since these ranges constrain IPO pricing on the Neuer Markt, but not on Nasdaq where they serve as mere indications of likely IPO prices.

First, Panel A of Table 4 shows that the standard deviation of the range center is higher for our sample of Neuer Markt IPOs than for the Nasdaq IPOs. A variance ratio test confirms that this difference is statistically significant. This is consistent with the notion that Nasdaq underwriters put less consideration into where they set price ranges than do underwriters on the Neuer Markt. Furthermore, we find that within the sample of Nasdaq IPOs, the standard deviation of the range center is higher for the group of IPOs with final price ranges set late (i.e. within a week of pricing, $t_P - t_R \leq 7$ days) than across the other IPOs. Again, a variance ratio test rejects that there is no difference. This suggests that Nasdaq underwriters put more consideration into setting price ranges shortly before setting the offer price, than at the start of the pricing process.

Next, we consider the size of the final price ranges of IPOs on the two markets, as a percentage of the range center. While the average range size is comparable across markets, a variance ratio test reveals that final price ranges vary more in size across IPOs on the Neuer Markt than across Nasdaq IPOs. Similar to the results discussed above, this suggests that, in setting these ranges, underwriters on the Neuer Markt pick the range size deliberately, perhaps due to concerns about losing flexibility in IPO pricing. Looking at the absolute rather than the relative size of price ranges underscores this notion: while the upper and lower bounds of the final price ranges differ by exactly US$2 for more than 95% of our Nasdaq IPOs, the absolute range size varies considerably across IPOs on the Neuer Markt. On Nasdaq it thus appears that underwriters set the range size "by default", rather than considering it as a decision variable, as on the Neuer Markt.

Panel B of Table 4 shows the distribution of IPO prices around the final price ranges. As discussed in Section 2, this distribution differs between Nasdaq and the Neuer Markt: while pricing IPOs above these ranges is common on Nasdaq, underwriters on the Neuer Markt

refrain from that. Besides this difference, there are also some similarities. Most important, it seems as if underwriters on both markets set price ranges "too low" in order to deliberately price most IPOs at the top of these ranges or above. This is true even for the pricing of Nasdaq IPOs relative to ranges set late, i.e. less than a week before ($t_P - t_R \leq 7$ days): more than 70% of these IPOs are priced above the ranges.

Table 5 provides summary statistics for two further variables that characterize IPO pricing. The first of these variables is the price revision, i.e. the percentage by which underwriters price IPOs above or below the midpoints of the final price ranges. The second is the initial return of IPOs, i.e. the percentage return between the prices at which IPO shares are sold in the primary market and the first day closing prices. Again, we find interesting differences between the two markets. Consistent with the fact that IPOs on the Neuer Markt are never priced above the price ranges, the average price revision is about one third of the average across Nasdaq IPOs. This difference is statistically significant even after taking into account that the standard deviation of the price revision is also significantly higher across Nasdaq IPOs. Moreover, the two samples of IPOs differ in initial returns: the average initial return of the Nasdaq IPOs is significantly higher than that of the IPOs on the Neuer Markt. Splitting the Nasdaq IPOs into groups shows that this difference between the two markets is largely driven by those Nasdaq IPOs that get priced relative to final price ranges set late, i.e. less than one week before ($t_P - t_R \leq 7$ days). Indeed, the initial returns of these IPOs are significantly higher than those of both the other Nasdaq IPOs, and the IPOs on the Neuer Markt.

5.2 IPO Pricing on Nasdaq and the Neuer Markt

In this section, we analyze the pricing of IPOs on Nasdaq and the Neuer Markt. Besides setting the stage for the analysis of initial returns in the next section, we explore effects of institutional differences between the two markets that are described in Section 2. To do this, we specify an empirical model for the pricing of IPOs relative to the final price ranges. For Nasdaq IPOs, these price ranges are sometimes set by way of range amendments that happen usually within the week before pricing. To control for effects of such "late" range amendments, we distinguish in our model of IPO pricing between the two groups of Nasdaq IPOs with final

price ranges set more or less than one week before the pricing date (i.e. $t_P - t_R > 7$ days and $t_P - t_R \leq 7$ days respectively). On the Neuer Markt, there is no substantial variation in when the final (and only) price ranges are set. Further, the time of setting these ranges marks the onset of pre-IPO trading of IPO shares in the grey market. To explore the information content of grey market prices, we include these prices as explanatory variables in our model of IPO pricing. Apart from any changes in the analysis that are induced by the need to control for such market-specific institutional features, we implement the same empirical model of IPO pricing for Nasdaq and the Neuer Markt. To develop this model, we build on results of previous studies of IPO (under-)pricing, discussed below. Table 6 states the notation and exact definitions of our explanatory variables. We denote indicator variables as "I" and use "ˆ" to denote instruments for endogenous explanatory variables.

The first group of papers identifies **underwriter reputation** as a potential explanatory variable for the pricing of IPOs. Consistent with Titman and Trueman's (1986) model, Carter and Manaster (1990), Booth and Chua (1996), and Lowry and Schwert (2002) find that initial returns are negatively related to underwriter reputation. Using only data from the 1990's, Beatty and Welch (1996) and Habib and Ljungqvist (2001) find a positive relation. But, Habib and Ljungqvist also provide evidence that underwriter reputation is endogenous. To avoid an endogeneity bias, we therefore instrument underwriter choice. The set of instruments is based on the notion that renowned underwriters may be chosen for IPOs that are expected to generate higher proceeds (Habib and Ljungqvist (2001)) or for IPOs of larger issuers (Beatty and Welch (1996)). Specifically, we use as instruments the last total assets figure that is available for issuers prior to their IPOs ($ASSETS$) and indicator (dummy) variables for (i) whether an issuer intends to sell only a small fraction of the stock ($I_{FSOLD<MEDIAN}$), (ii) whether the issuer expects to raise below-median-level proceeds ($I_{EPROC<MEDIAN}$), (iii) whether the issuer's expected market capitalization is below-median ($I_{EMACP<MEDIAN}$) as well as (iv) fixed effects for how market conditions may vary across IPOs in different months.[20] Summary tables for underwriter identity are stated in the Appendix, along with Carter-Manaster ranks for

[20]Expected IPO proceeds and expected market capitalization are computed using the center of the final range as the expected share price. We use dummy variables to avoid the potential problem that this range center may be endogenous. Also, the exact fraction of shares to be sold at the IPO may be endogenous.

underwriter reputation. While fewer than half of our sample of Neuer Markt IPOs were underwritten by banks with Carter-Manaster ranks above 7, this is the case for almost all of the Nasdaq IPOs. As a consequence, we choose different cut-off values to identify renowned underwriters on Nasdaq and the Neuer Markt: for Nasdaq, the dummy $I_{REN.UNDERWRITER}$ equals one for IPOs underwritten by banks ranked above 9; for the Neuer Markt, this dummy equals one for IPOs with underwriters ranked above 7.

A second group of papers analyzes the relation between IPO underpricing and **issue(r) characteristics**. As in Lowry and Schwert (2001) and (2002), we capture size-effects on the pricing of IPOs by using control variables such as the last total assets figure that is available for the issuers. We deviate from some papers in the literature by not including a control variable for venture capital backing: Bradley and Jordan (2001) find this to be insignificant after controlling for whether the IPO was in a high technology industry. As all of our IPOs are high technology firms we do not expect venture capital backing to be a significant explanatory variable within our sample. Finally, Habib and Ljungqvist (2001), Loughran and Ritter (2002) and (2001), and Bradley and Jordan (2001) find that initial returns are negatively related to the fraction of an issuer's outstanding shares that are sold in the IPO ($FSOLD$). While we seek to control for such an effect, we are concerned that issuers endogenously adjust this fraction in response to or in anticipation of information that underwriters gather through bookbuilding. Therefore, we instrument this variable using as instruments measures of issuer size as well as (if available) the proposed fraction sold as reported in a time t'_R filing that states the price range *before* the last range amendment ($FSOLD_{BEF}$).[21]

The third group of studies deals with the effect on underpricing of the **IPO pricing process up to the setting of the final price ranges**. Bradley and Jordan (2001) and Boehmer and Fishe (2001) consider the relation between range amendments and initial returns. Bradley and Jordan find that this relation is significantly positive but convex in that it is stronger for positive than for negative range amendments. These findings suggest that underwriters may set price ranges in order to deliberately affect the subsequent price revision. Our approach is somewhat different in that we want to allow for the possibility of this happening, even if

[21] This instrument is available only for some Nasdaq IPOs with final price ranges set through range amendments.

the final range is not the result of a range amendment. Thus, for all IPOs we will use the range-center ($RCENTER$) itself as an explanatory variable to help us explain the relation between the pricing process up to the point of setting the final range and the revision of the offer price from this range. As the range center is clearly endogenous, we instrument it using measures of issuer size and proxies for the primary market conditions during the three weeks prior to the filing at time t_R that first states the range (i.e. the variables with the subscript $t_R - 3w$ in Panel B of Table 6). For Nasdaq IPOs with final ranges that were set through range amendments we use slightly different proxies for market conditions (i.e. the variables with the subscript $t'_R \rightarrow t_R$ in Panel B of Table 6) as well as the prior range center ($RCENTER_{BEF}$). Finally, we take into account that the range center is set simultaneously (i.e. in the same filing) with the fraction sold of issuers' shares outstanding ($FSOLD$): as stated in Table 6, we instrument each of these variables using the same set of instruments.[22]

The final group of papers deals with the effect of **primary and secondary market conditions** on IPO underpricing. Bradley and Jordan (2001), Loughran and Ritter (2002) and Lowry and Schwert (2002) all found that initial returns are positively related to the performance of secondary market indices prior to the IPOs. The latter two papers also allow this relation to be piecewise linear and find that it is strongest for positive secondary market returns. Further, Bradley and Jordan (2001) and Lowry and Schwert (2002) show that initial returns are also positively related to primary market conditions, i.e. the average initial return of recent IPOs. Given these results, we allow for a piecewise linear relation of price revision to both primary and secondary market performance. To obtain indices for primary market conditions, we compute for each IPO in our sample the average initial return of IPOs on Nasdaq and the Neuer Markt between the time t_R at which the final price range is set and the time t_P of pricing the IPO. In addition to these indices for primary market conditions (denoted as $\bar{IR}^{NQ}_{t_R \rightarrow t_P}$ and $\bar{IR}^{NM}_{t_R \rightarrow t_P}$), we use the return of the Nasdaq Computer Index and the Neuer Markt All Share Index during the same period of time ($IX_{t_R \rightarrow t_P}$) to control for secondary market per-

[22]For example, we instrument $RCENTER$ using the same instruments as for $FSOLD$. This can be seen as an unrestricted reduced form of a structural model explaining simultaneously the range center and the fraction of an issuer's stock sold in an IPO. To estimate this model, we use SUR, thus allowing for correlation between the unexplained residuals of the two dependent variables.

formance. For all of these variables, we estimate a piecewise linear effect on IPO pricing with "kinks" at the variables' 75%-percentiles.[23] Finally, we take into account findings by Booth and Chua (1996) and Benveniste, Ljungqvist, Wilhelm and Yu (2001) that initial returns are negatively related to the number of recent IPOs in the same industry. To capture this effect, we include as measures for **IPO activity** the number of high-tech IPOs on Nasdaq and on the Neuer Markt that occur during the period between setting the final range and setting the offer price ($N^{NM}_{t_R \to t_P}$ and $N^{NQ}_{t_R \to t_P}$).[24]

To summarize, we estimate the following model for how underwriters revise the offer price from the center of the final range:

$$\begin{aligned} PREV^* = \; & f(\textit{underwriter reputation}, \;\; \textit{issue}(r) \textit{ characteristics}, \\ & \textit{IPO pricing process up to range setting}, \\ & \textit{primary \& secondary market conditions}, \;\; \textit{IPO activity}) + \varepsilon, \end{aligned} \tag{5}$$

where the dependent variable $PREV^*$ is the price revision from the center of the price range to the offer price, as a percentage of the offer price.[25] Table 6 summarizes and presents the exact definitions of all of the variables included in each of the broad categories in equation (5). In the remainder of this section we estimate this model.

5.2.1 IPO Pricing on the Neuer Markt

To estimate model (5) for IPOs on the Neuer Markt, we must take into account that the price revision is a right-censored variable since IPOs are not priced above the upper bounds of their price ranges. This implies that we need a TOBIT model. In estimating this model, we must allow for heteroscedasticity since IPOs may differ in the extent to which underwriters gather

[23] We use superscript + to denote the explanatory variables that capture these kinks. These variables equal those without the superscript if these variables take values exceeding the 75%ile, and zero otherwise.

[24] Note that we do not include data on withdrawn offerings. However, as argued by Benveniste, Ljungqvist, Wilhelm and Yu (2001) this is endogenous and we do include many of the variables that they use to explain the probability of withdrawal. In addition, we have run robustness checks of our results by repeating our entire analysis using only data for the years 1999 and 2000. As there were almost no withdrawals in 1999 but a number in 2000, we should obtain different results if withdrawals matter. However, the results are the same and are also very similar to those reported.

[25] We use the notation $PREV^*$ (which is really the latent price revision), because in our regressions for IPO pricing on the Neuer Markt we estimate a TOBIT model to account for the fact that the price revision $PREV$ is constrained. (For unconstrained Neuer Markt IPOs and for our Nasdaq analysis $PREV^* = PREV$, which is the actual price revision.) Note also that we express both the price revision and initial returns as percentages of the offer price: by choosing the same normalization for both variables, we remain consistent with the equations in Section 3.

information during bookbuilding.[26] Since we expect that the informational role of bookbuilding may vary across underwriters and may also be affected by market conditions, we control for heteroscedasticity across groups of IPOs underwritten in the years 1999 and 2000 by more, or less, renowned banks (with Carter-Manaster ranks above, or below, 7 respectively).

Table 7 states the results. Panel A reports the models used for instrumenting the endogenous variables. Panel B contains the results from estimating the model (5): column (1) reports the base model; in columns (2) and (4) we treat endogenous variables as exogenous (i.e., we include the actual variables instead of the respective instruments); in columns (3) and (4) we analyze how underwriters respond to pre-IPO (grey market) trading. In these last two columns we do not include other market variables, because along with the grey market return, none of the market condition variables is significant.

The estimates confirm results of studies cited above but also establish several new results. As Habib and Ljungqvist (2001), we find no significant effect of underwriter choice on IPO pricing if we instrument the dummy variable $I_{REN.UNDERWR}$ that indicates IPOs with an underwriter that has a Carter-Manaster ranking above 7. Also, we confirm that there is a negative relation between the price revision and issuer size (as measured by total assets, $ASSETS$) and an effect of market conditions on IPO pricing. This is true for both seconary market conditions (as measured by the return on the Neuer Markt All Share Index, $IX_{t_R \to t_P}$) and primary market conditions (as measured by the average initial return of recent IPOs on the Neuer Markt, $\bar{IR}^{NM}_{t_R \to t_P}$).

As a novel result, we show that there is also a significant cross-market effect: as indicated by the p-value of the sum of the coefficients of the variables $\bar{IR}^{NQ}_{t_R \to t_P}$ and $\bar{IR}^{NQ+}_{t_R \to t_P}$ (stated at the bottom of column (1) of Table 7, Panel B), IPO pricing on the Neuer Markt is positively and significantly related not only to the average initial return of recent IPOs on the Neuer Markt, but also to those of Nasdaq IPOs. This cross-market effect is significant only for those Nasdaq IPOs in industries similar to our Neuer Markt sample. While not reported in Table

[26] The disturbance term, ϵ, captures in model (5) any variation in IPO prices left unexplained after controlling for public information. One source of such variation is any non-public information that underwriters receive during bookbuilding. Thus, heteroscedasticity affects our estimates if there is variation across IPOs in the extent to which bookbuilding generates such information.

7, we find no significant relation between the pricing of our sample of high-tech IPOs on the Neuer Markt and the average initial return of contemporaneous Nasdaq IPOs in *all* industries.

Finally, we test the hypothesis **GREY** about how underwriters on the Neuer Markt adjust IPO prices relative to information revealed through pre-IPO trading. In columns (3) and (4) of Panel B we regress the price revision on $GREYMKT$, the percentage difference between the range center and the last grey market price on the day before the pricing of IPOs.[27] As indicated by the p-values stated at the bottom of the table, the coefficients in both columns are significantly smaller than one. We thus reject the hypothesis **GREY** that underwriters fully adjust IPO prices in response to all information contained in grey market prices. What we find instead is partial adjustment, as if underwriters need to cede informational rents (in the form of initial returns) to investors for information that is revealed by grey market trading.

On the surface this appears at odds with the fact that grey market prices are publicly available. However, as discussed in Section 3, underwriters on the Neuer Markt may collect information *prior to* the onset of grey market trading (and bookbuilding) at time t_R. While such information helps the underwriters to set price ranges appropriately, it can be publicly revealed by the grey market prices only after these ranges are set. Our findings suggest that informational rents are indeed paid for such information that underwriters gather prior to bookbuilding: partial adjustment of IPO prices relative to grey market prices cannot be due to rents for any information that is gathered during bookbuilding and is simultaneously available for free in the form of grey market prices. Also, underwriters cannot wait for grey market trading to reveal information that is needed to set price ranges since these ranges are set before trading starts. We thus conclude that, in rejecting the hypothesis **GREY**, we find evidence consistent with informational rents being paid for information that helps underwriters to set price ranges prior to bookbuilding.

This result is further supported by the fact that the coefficent on the grey market return is higher in column (4) than in column (3). The difference comes about because we instrument endogenous variables in column (3) while including the actual values of these variables in

[27] Note that testing hypothesis **GREY** requires that we choose the same normalization for the price revision and the $GREYMKT$ variable: as stated in Table 6, both variables are defined as percentage of the offer price.

column (4), thus treating as exogenous underwriter choice, the final price ranges of IPOs, and the fraction of issuers' stock to be sold. In contrast to the instruments, these variables contain information generated by the IPO pricing process before the start of bookbuilding. Once we control for this information in column (4), the partial adjustment effect with respect to the grey market return weakens.

5.2.2 IPO Pricing on Nasdaq

Because of institutional differences and differences in the level of IPO activity between Nasdaq and the Neuer Markt, we deviate in three respects from the approach taken in the last section to estimate model (5). First, we do not use a TOBIT model since underwriters of Nasdaq IPOs frequently set offer prices above the final price ranges. Second, the greater availability of data allows us to control for heteroscedasticity even better than in the last section. Thus, we estimate a Prais-Winsten FGLS model, controlling for heteroscedasticity across groups of IPOs with the same underwriter that start trading during the same interval of six months. Third, we must take into account that the duration of time between range setting and pricing, $t_P - t_R$, varies much more on Nasdaq than on the Neuer Markt. We suspect that this variation may be associated with differences in the nature of bookbuilding as a means for both distributing shares, and gathering information. In particular, we expect that information gathering is of less importance after range amendments that happen within the week before pricing, i.e. for $t_P - t_R \leq 7$ days. We therefore split our sample of Nasdaq IPOs into two subsamples with $t_P - t_R > 7$ days and $t_P - t_R \leq 7$ days respectively and estimate model (5) separately for each of these subsamples.[28]

The results are stated in Table 8 where Panel A presents models used for instrumenting endogenous variables and Panel B contains results from estimating model (5). In columns (1) and (2) we include the instrumented variables; in (3) and (4) we treat these endogenous variables as exogenous.

We obtain several results that correspond to findings discussed in the last section. As on the

[28]Note that we cannot separate the effect of range amendments from the effect of a short duration of bookbuilding itself. This is because the final price range is always set through range amendments if $t_P - t_R \leq 7$ days, and there are no range amendments for 90% of the IPOs with $t_P - t_R > 7$ days. We do, however, control for information released with earlier range postings.

Neuer Markt, there is evidence for a significant effect of recent primary and secondary market conditions on the price revision. Also, there are again significant cross-market effects since Nasdaq IPOs experience a higher price revision following high-tech IPOs on the Neuer Markt with high average initial returns. In terms of point estimates, the cross-market influences are not as strong for the pricing of Nasdaq IPOs as for the pricing of IPOs on the Neuer Markt. This is not surprising considering the relative sizes of the markets.

Finally, we find that, similar to the Neuer Markt, the instruments for the range center, the fraction of an issuer's stock to be sold, and underwriter reputation have no explanatory power while these variables have significant effects if treated as exogenous. However, the signs of the coefficients of these variables in column (3) differ from those in column (4) of Table 7, Panel B. For the effect of underwriter reputation, this is not surprising since previous studies (cited above) also find contradictory evidence. For the coefficients of the range center and the fraction sold, we expect that the different signs are a consequence of differences in the way in which underwriters set price ranges. For example, if ranges are set randomly, then on average those IPOs with higher range centers should have lower price revisions, and the range center should have a negative coefficient for explaining price revisions. This is exactly what we find for Nasdaq IPOs with early ranges. If on the other hand, ranges are set so as to incorporate, but only partially, information that is gathered prior to setting the ranges, then the range center should have a positive coefficient for explaining price revisions. This is what we find for the Neuer Markt and for Nasdaq IPOs with ranges set late, although the latter coefficient is not statistically significant.

5.3 Initial Returns

In this section, we analyze differences in IPO underpricing on Nasdaq and the Neuer Markt. Specifically, we estimate empirical models based on equations (3) and (4) to test the hypotheses stated in Section 3. Thereby, we draw on the results of the last section: we assume that the model (5) determines $PREV_0$, i.e. the price revision if the underwriter receives no private information ($i = 0$). We realize that this assumption may not be fully satisfied since we may fail to capture some publicly available information of relevance for IPO pricing. However, our

central results should be robust to that. To see this, note that many of the hypotheses in Section 3 concern the relative strength of the relation between the price revision and initial returns. While there may be some "omitted variable bias" of the absolute values of coefficients measuring this relation, it is unlikely that this changes their *relative* magnitude. As a worst case, such a bias may thus affect tests of hypotheses about the absolute magnitude of the coefficients of equations (3) and (4),[29] but we should obtain robust results in testing hypotheses $\mathbf{STICKY_{NM}}$ and $\mathbf{STICKY_{NQ}}$ about their relative sizes.

5.3.1 Initial Returns on the Neuer Markt

In order to analyze IPO underpricing on the Neuer Markt, we need to convert equation (3) into an econometric model. Thereby, we face the problem that we can directly observe the latent price revision $PREV^*$ only for IPOs priced within or below their price ranges. However, a specific institutional feature of the Neuer Markt allows us to address this problem: pre-IPO trading in the grey market should reveal any information of relevance for IPO pricing, including non-public information i about the value of IPO shares.[30] As a consequence, we use the model in column (3) of Table 7, Panel B, to compute the price revision $PREV^*$ that would have been observed for IPOs with constrained offer prices if pricing had not been restricted by the price ranges. We denote this price revision by $PREV_G$. Using this variable, model (3) can be written as follows:

$$IR = IR_0 + \begin{cases} \gamma_U \times (PREV - PREV_0) \; + \; \epsilon_U & \text{if } \; I_{CON} = 0, \\ \gamma_C \times (PREV_G - PREV_0) \; + \; \delta \times (PREV_0 - MAXREV) \; + \; \epsilon_C & \text{if } \; I_{CON} = 1, \end{cases} \tag{6}$$

where ϵ_U and ϵ_C denote econometric disturbances. In estimating model (6), we allow for the disturbance variance to differ between IPOs with constrained offer prices and the other IPOs. Further, we use several control variables to capture IR_0, the part of initial returns that can be predicted using information that is publicly available prior to IPO pricing. Besides variables for issuer size and market conditions, this includes also information contained in the filings that set the final price ranges at time t_R. Specifically, we control for the midpoints of these ranges

[29] However, this problem is always present in empirical studies of the "partial adjustment phenomenon" as evidence for the informational role of bookbuilding modelled by Benveniste and Spindt (1989).

[30] Indeed, Löffler, Panther, and Theissen (2001) show that grey market prices are unbiased estimates of the price at which trading of IPO shares opens in the secondary market.

and the fraction of issuers' stock to be sold in IPOs as stated in these filings. By including these control variables, we seek to isolate in the coefficients γ_U and γ_C the relation between initial returns and information that underwriters obtain through bookbuilding after time t_R.

Table 9 presents the results of estimating the above-stated model. Panel A reports descriptive statistics for the central explanatory variables of the regressions stated in Panel B.[31] Of these, the variable $PREV_0$ is the latent price revision if underwriters receive no private information during bookbuilding, i.e. $i = 0$. We compute this price revision using the regression reported in column (1) of Table 7, Panel B.[32] We then calculate the following variables that correspond to various terms of model (6):

- $SURP = PREV - PREV_0$ denotes the "surprise" component of the price revision of IPOs with unconstrained offer prices,
- $SURP_G = PREV_G - PREV_0$ denotes the "surprise" component of the latent price revision of IPOs with constrained offer prices, and
- $CEXTENT = PREV_0 - MAXREV$ denotes the percentage by which offer prices are constrained, for $i = 0$.

The descriptive statistics in Panel A reveal a striking result. For the IPOs with constrained offer prices, the price ranges induce very substantial price stickiness even if bookbuilding generates no information of relevance for IPO pricing, $i = 0$: $CEXTENT$ is on average equal to 20.7% of the offer price (with a maximum of 81.6%). For issuers, this implies that money is left on the table. Upon multiplying $CEXTENT$ by issue size, we can calculate the cost in terms of foregone IPO proceeds. Per IPO with a constrained offer price, on average more than 16 million Euros were left on the table due to lack of flexibility in revising upwards the offer price. Across the 79 IPOs with a constrained offer price, the total amount of money left on the table is more than one billion Euros!

[31] In the regressions of Panel B we interact the grey market return with the indicator variable I_{CON} which indicates constrained IPOs. As discussed in Section 4, we do not have appropriate grey market returns for ten of our Neuer Markt IPOs. Of these, three had constrained prices. Thus our number of observations for the regressions of Table 9, Panel B drops from 117 to 114.

[32] We choose this model rather than that in column (2) in order to avoid endogeneity bias. We do not use the models in columns (3) and (4) for estimating $PREV_0$, because grey market prices contain information i that underwriters obtain through bookbuilding.

Panel B of Table 9 contains the results from estimating model (6). Columns (1) and (2) report estimates for the basic equation, obtained after substituting in equation (6) for $CEXTENT$, $SURP$, and $SURP_G$:

$$IR = IR_0 + \begin{cases} \gamma_U \times SURP \ + \epsilon_U & \text{if } I_{CON} = 0, \\ \gamma_C \times SURP_G \ + \ \delta \times CEXTENT \ + \ \epsilon_C & \text{if } I_{CON} = 1, \end{cases} \qquad (6')$$

In column (3) we test the constraint imposed implicitly in the above-stated model that the two "components" of $CEXTENT$, i.e. $PREV_0$ and $-MAXREV$, have the same coefficient: we cannot reject this constraint (p-value of 0.813, given at the bottom of column (3)). In column (4) we test similar constraints imposed implicitly by using the above-stated definitions of the "surprise variables", $SURP$ and $SURP_G$. Again, we cannot reject these constraints (p-values of 0.750 and 0.838, respectively). Given these results, we focus on the regressions of columns (1) and (2) in the discussion below.

Informational role of bookbuilding: As discussed in Section 3, rejecting hypotheses $\mathbf{INFO_U}$ and $\mathbf{INFO_C}$, against the alternatives of $\gamma_U > 0$ and $\gamma_C > 1$ would be consistent with an informational role of bookbuilding as modelled by Benveniste and Spindt (1989).[33] However, testing these hypotheses shows that there is no evidence for this: according to the p-values stated in the bottom of Table 9, the coefficients γ_U and γ_C of the surprise variables $SURP$ and $SURP_G$ are not significantly different from zero and one respectively.[34] Thus, for Neuer Markt IPOs we find no evidence of an informational role of bookbuilding as in the model by Benveniste and Spindt (1989).

To interpret this result, we need to keep in mind that the bookbuilding period is rather strictly defined as the period after the time t_R at which price ranges are set (typically only one week prior to pricing). Thus, our result may just indicate that underwriters' information gathering is completed by that time. However, it may also be the case that underwriters do gather information after time t_R but that they can obtain this information at zero cost. This

[33] To see this, note that underwriters must partially adjust IPO prices with respect to information i that they receive through bookbuilding in order to induce that investors post informative orders: in terms of equation (3.1), investors must receive informational rents of $(1-\beta) \times i > 0$ since $\beta < 1$. Using the definitions stated below equation (3), $\beta < 1$ implies that $\gamma_U = (1-\beta)/\beta > 0$ and $\gamma_C = 1/\beta > 1$.

[34] As discussed above, this result is robust to relaxing the constraints that are implicitly imposed by substituting these surprise variables into model (6).

interpretation is consistent with an institutional difference between Nasdaq and the Neuer Markt, i.e. the existence of the "grey" forward market for IPO shares. After this market opens at time t_R, bookbuilding may provide underwriters only with such information that is also contained in grey market prices. As these prices are freely and publicly available, there should not be any informational rents associated with gathering this information.

Stickiness of IPO prices: In model (6′) and equation (3), any effect that constrained IPO pricing may have on initial returns is captured by the coefficient δ of $CEXTENT$ and by the difference $\gamma_C - \gamma_U$. Hypotheses **DELTA** and $\mathbf{STICKY_{NM}}$ state that, under the assumption that bookbuilding generates information to an extent that does not vary with underwriters' flexibility in IPO pricing, $\delta = 1$ and $\gamma_C - \gamma_U = 1$. However, this assumption may not be satisfied: as discussed above the statement of hypothesis $\mathbf{STICKY_{NM}}$, underwriters' flexibility in IPO pricing may affect how much information they obtain during bookbuilding. In terms of model (6′), this implies that the coefficients γ_C and γ_U may differ by more or less than one. As indicated by the p-values stated in the bottom of Table 9, Panel B, we can reject neither the hypothesis $\mathbf{STICKY_{NM}}$, nor **DELTA** . Thus, it appears as if lack of flexibility in IPO pricing has no effect on the extent to which bookbuilding generates information. Of course, this result is perhaps another confirmation of our findings discussed above, i.e. that there is no significant evidence for an informational role of bookbuilding at all.

5.3.2 Initial Returns on Nasdaq

In our analysis of IPO underpricing on Nasdaq, we again distinguish between two groups of IPOs: those for which the final range was in place "early" (more than one week before pricing, $t_P - t_R > 7$ days) and those for which the final range was set "late" (within a week of the pricing date, $t_P - t_R \leq 7$ days). By drawing this distinction, we can analyze how underwriters respond in IPO pricing to information obtained at different times during bookbuilding. Specifically, we will look for variation in the extent to which underwriters incorporate new information into the offer price for these two sets of IPOs. To do this, we implement an econometric model corresponding to equation (4), but we allow for different coefficients and heteroscedasticity

across the two groups of IPOs.[35]

Panel A of Table 10 reports summary statistics for the most important right-hand-side variables of the regressions in Panel B. Besides the price revision $PREV$, this includes the surprise price revision, $SURP = PREV - PREV_0$, where the expected price revision $PREV_0$ is computed using the estimates in columns (1) and (2) of Table 8, Panel B.[36] By comparing these variables across the two groups of IPOs we find that the variance of both variables is smaller for those IPOs with final price ranges set late. While the price revision $PREV$ is positive for most IPOs in both groups, $SURP$ is on average equal to zero (due to the way that the surprise component of the price revision is calculated).

Panel B of Table 10 reports the regression results. Columns (1) and (2) report results for the basic equation, without control variables. Columns (3) and (4) repeat this regression with control variables (defined in Table 6). In columns (5) and (6) we repeat the regression of columns (3) and (4), but with the actual price revision $PREV$, instead of the surprise $SURP$. Comparing the coefficients of $PREV$ and $SURP$, shows that these two variables explain initial returns with very similar coefficients. This is natural since the information in the surprise variable is orthogonal to the publicly available information in the expected price revision $PREV_0$. After controlling for such information, the coefficients of $SURP$ and $PREV$ should therefore be equal. Columns (5) and (7) present the results of repeating the regression of columns (5) and (6), but with the percent value of earlier range amendments, $RAMEND$, included as a control variable for IPOs with late ranges.[37] This last regression is included as a robustness check and is discussed below when we discuss price stickiness. Except for that, we focus mostly on the estimates in columns (1) - (4).

Informational role of bookbuilding: We reject both of the hypotheses $\mathbf{INFO_E}$ and $\mathbf{INFO_L}$ stating that $\gamma_E = 0$ and $\gamma_L = 0$ respectively. As discussed above, rejecting these hypotheses against the alternative of a positive coefficient is consistent with an informational role of bookbuilding as modelled by Benveniste and Spindt (1989). In contrast with the Neuer Markt

[35] Note that we deviate from equation (4) by also allowing for differences in IR_0, the initial returns if $i = 0$.

[36] We use these estimates instead of those in columns (3) and (4) since we seek to avoid any endogeneity bias.

[37] The coefficients of column (5) are not affected by the addition of this variable, so we do not write this column a second time.

results, an informational role of bookbuilding thus seems to exist even shortly before IPO pricing: the coefficient of the surprise variable is significantly positive even for IPOs priced relative to price ranges amended less than seven days before pricing.

Stickiness of IPO prices: As indicated by the p-values stated in the bottom of Table 10, Panel B, we reject the hypothesis $\mathbf{STICKY_{NQ}}$ that $\gamma_E = \gamma_L$ in equation (4). This suggests that there is variation across IPOs in the extent to which underwriters respond in IPO pricing to information that they obtain through bookbuilding. In particular, underwriters seem to be relatively reluctant to incorporate information into IPO pricing after a range amendment that occurs "late", i.e. shortly before pricing. If the information is favorable, $SURP > 0$ this "price stickiness" implies that investors realize significantly higher initial returns. Based on the point estimates for the coefficients γ_E and γ_L, an increase by 1% in the surprise price revision $SURP$ is associated with initial returns being higher by $1\% \times (\gamma_L - \gamma_E) \approx 3.5\%$ if this price revision occurs after a late range amendment.[38] Columns (5) and (7) show that this difference in initial returns is not driven by "partial adjustment" in earlier range amendments: after controlling for the size of these range amendments, $RAMEND$, the difference drops only by a small amount, to 3.1%.[39]

6 Bookbuilding on the Neuer Markt versus Nasdaq: Conclusion

In this section, we summarize the results of the previous analysis in order to put into perspective how the pricing of IPOs differs in three respects between Nasdaq and the Neuer Markt. First, we present evidence suggesting that preliminary price ranges are set more deliberately on the Neuer Markt than on Nasdaq. We find support for this notion in three places: (i) The descriptive statistics discussed in Section 5.1 indicate that, on the Neuer Markt, price ranges of IPOs exhibit more variation in their level and their width, than do price ranges of Nasdaq IPOs. (ii) IPO pricing on the Neuer Markt shows a partial adjustment of IPO prices relative to prices established by grey market trading of IPO shares. As discussed at the end of section

[38] This difference of 3.5% is found both in the regressions reported in columns (3) and (4) and those in columns (5) and (6).

[39] The result is also not driven by differences in the distribution of the surprise price revision $SURP$ across the two groups of IPOs: in both groups, $SURP$ takes positive / negative values for roughly 50% of the IPOs.

5.2.1, this suggests that investors receive informational rents for providing underwriters with private information that helps them to set price ranges appropriately *before* this information gets incorporated into the freely available grey market prices. (iii) As discussed at the end of Section 5.2, underwriters on the Neuer Markt seem to set price ranges deliberately: inconsistent with the ranges being set randomly, we find a positive relation between the midpoints of these ranges and the subsequent revision of IPO prices from these midpoints.

Our second set of results relates to the first of our research questions: Does bookbuilding serve mainly as a method for distributing shares, or also as a means for gathering information? As reported in Section 5.3.1, we find no evidence of an informational role of bookbuilding on the Neuer Markt. While this result may just indicate that underwriters' information gathering is completed before the start of bookbuilding, it may also be the case that the grey market substitutes for bookbuilding as a source of information. In any case, the purpose of bookbuilding appears to differ between Nasdaq and the Neuer Markt: contrary to our findings for IPOs on the Neuer Markt, we find evidence of an informational role of bookbuilding for Nasdaq IPOs. As discussed in Section 5.3.2, this is true even shortly before the pricing of these IPOs.

Our third set of results relates to the second research question: Do IPOs differ in the extent to which underwriters respond in IPO pricing to information that they obtain during bookbuilding? On the Neuer Markt, IPO pricing is effectively constrained once price ranges are set. In Section 5.3.1., we estimate the cost of this constraint in terms of foregone IPO proceeds. On Nasdaq, there is no such "pricing restriction". However, we find a different form of price stickiness. As discussed in Section 5.3.2, the partial adjustment phenomenon is significantly stronger for IPOs that are priced relative to final price ranges set shortly before pricing. Thus, underwriters in both markets appear to be less flexible in responding to "last minute" information. If this information is favorable, then IPO prices are revised upwards by less, and more money is left on the table for investors.

These results are related to specific institutional differences between Nasdaq and the Neuer Markt. The most important of these differences is that, on the Neuer Markt, investors submit binding orders during the bookbuilding period rather than mere indications of interest, as is common on Nasdaq. After collecting such binding orders, underwriters on the Neuer Markt

cannot price IPOs above the preliminary price ranges that are set at the start of bookbuilding. As indicated by our results, this difference affects the entire bookbuilding process: (i) because ranges constrain IPO pricing, it is important to set price ranges appropriately; (ii) to do this, underwriters on the Neuer Markt gather more information before setting the price ranges and less after that. Indeed, there is no evidence at all for an informational role of bookbuilding after price ranges are set on the Neuer Markt.

Based on the results presented, "bookbuilding" should not be used as a generic term. Instead we have shown how institutional differences between Nasdaq and the Neuer Markt affect the extent to which IPO prices are "sticky". On the Neuer Markt we can identify the institutional source of this price stickiness as stemming from a two-sided commitment on the part of investors and underwriters: investors to buy shares and underwriters to limit the price. On Nasdaq we find evidence of stickiness, despite being unable to relate this to a clear institutional source. We suspect that the stickiness on Nasdaq is due to a somewhat less formal form of commitment between underwriters and investors. We also want to emphasize that even though we find that pricing constraints are costly, we make no judgements as to whether they are good or bad. As we know from the theory of strategic interactions, being able to precommit to particular actions can increase a player's outcome. And, despite the fixed nature of the constraint on the Neuer Markt, we do find that average underpricing is significantly lower for internet and high-tech Neuer Markt IPOs, as compared to similar Nasdaq IPOs for the same period of time.

Appendix. Underwriter and industry codes

For each sample (Neuer Markt and Nasdaq), if a bank appears at least 5 times (within its own sample) then it is listed with its own code within that sample. Otherwise it is coded as either "TOP", "OTH$^+$ or "OTH", depending on its Carter-Manaster reputation ranking (see Carter, Dark and Singh (1998) and Jay Ritter's website). Infrequent underwriters with a Carter-Manaster ranking of at least 9 (on a scale of 1 to 10) are coded as TOP. Those with a ranking < 9, but at least 7 are coded as OTH+. Those with a ranking < 7 are coded as OTH.

Table A: Neuer Markt Underwriters

Underwriter	Code	C-M Rank	# of IPOs
Banque Paribas	BQP	8.1	5
Bayerische Hypo und Vereinsbank	BHV	none	7
Commerzbank	COB	7.1	9
DG Bank Deutsche Genossenschaftsbank	DGB	none	24
Deutsche Bank/Deutsche Morgan Grefell	DMG	9.1	9
Dresdner Bank/Dresdner Kleinworth Benson	DKB	7.1	10
Gontard & Metal AG	GTD	none	5
HSBC	HSB	8.1	6
Sal. Oppenheim	SAL	none	4
Westdeutsche Landesbank	WLB	5.1	7
	TOP	≥ 9.0	6
	OTH$^+$	≥ 7.0 and < 9.0	4
	OTH	< 7.0	21
Total			117

Table B: Nasdaq Underwriters

Underwriter	Code	C-M Rank	# of IPOs
Bear Stearns	BST	8.1	18
BT Alex Brown	BTA	8.1	17
Chase H&Q	CHS	8.1	12
Credit Suisse First Boston	CSF	9.1	43
Donaldson Lufkin and Jenrett	DLJ	9.1	18
Goldman Sachs	GSS	9.1	41
Hambrecht & Quist	HAM	8.1	20
JP Morgan	JPM	9.1	7
Lehman Brothers	LHB	9.1	12
Merrill Lynch	MLY	9.1	19
Morgan Stanley	MSY	9.1	27
Robertson Stephens	RBS	8.1	38
Salomon Smith Barney	SSB	9.1	6
	TOP	≥ 9.0	2
	OTH$^+$	≥ 7.0 and < 9.0	25
	OTH	< 7.0	21
Total			326

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Table 1
Size of different IPO markets (number of IPOs)

Market	1996	1997	1998	1999	2000
NYSE	88	87	68	49	48
Nasdaq	**680**	**494**	**273**	**485**	**397**
AMEX	18	22	21	11	6
Frankfurt - Neuer Markt	**0**	**12**	**41**	**132**	**132**
Frankfurt - Amtlicher Handel	n.a.	10	16	27	15
LSE (UK only)	230	135	124	106	172
LSE (International)	52	41	33	28	38
Paris (Premier and Second Marches)	n.a.	n.a.	83	34	28
Paris (Nouveau Marche)	18	20	43	22	52

(Source: Stock Exchanges)

Table 2
Minimum Listing Requirements

Criteria:		Nasdaq	Neuer Markt
Issuer:	operating history*	1 year	3 years
	assets/equity**	net tangible assets US$4 million	equity EUR 1.5 million
		or market cap. US$50 million	
	profitability	net income US$750,000	
Issue:	size		EUR 5 million
	free float***	US$5 million	25% of market cap.
	market makers	3	2

*At Nasdaq, the operating history must exceed 1 year for issuers with a market capitalization below US$50 million.

**At the Neuer Markt, issuers' equity must exceed EUR 1.5 million at the time of the application for listing.

***At the Neuer Markt (Nasdaq), free float comprises shares held by beneficial owners of less than 5% (10%) of the equity, not including executive ownership. A smaller float of only 10% is required for Neuer Markt issues with a market cap above EUR 100 million.

Table 3
Descriptive Statistics

Market capitalization is the offer price times the number of shares outstanding after the IPO, not including any shares issued under the greenshoe option. Issue size is the offer price times the number of shares sold at the IPO, not including the greenshoe option. Fraction sold is the number of shares sold at the IPO divided by the number of shares outstanding (in %). Market capitalization and issues size are in million US$ for Nasdaq IPOs and million Euros for Neuer Markt IPOs respectively. Nasdaq IPOs are divided into two groups: IPOs with a "final" range that was set more than one week before the pricing date (early) and IPOs with a "final" range that was set within one week of pricing (late).

	Nasdaq			Neuer Markt
	total	early range	late range	
Market Cap.	(million US$)			(million EUR)
Mean	497.8	430.5	694.7	476.9
Std.Dev.	495.6	444.7	580.6	2,527.4
Median	341.0	313.4	484.0	138.6
Minimum	33.6	33.6	66.5	32.0
Maximum	4,827.7	4,827.7	2,682.8	27,000.0
Issue Size	(million US$)			(million EUR)
Mean	77.6	71.0	96.6	75.2
Std.Dev.	52.8	50.2	55.8	234.9
Median	62.6	60.0	80.0	38.3
Minimum	16.5	16.8	16.5	8.0
Maximum	408.0	408.0	300.3	2,489.4
Faction Sold	(%)	(%)	(%)	(%)
Mean	19.5	20.2	17.2	26.8
Std.Dev.	7.6	7.7	6.9	7.2
Median	18.3	19.0	15.4	25.3
Minimum	5.4	5.4	7.0	5.3
Maximum	50.0	50.0	40.0	49.8
No of Issues	326	243	83	117

Table 4

Summary Statistics: Ranges and Pricing relative to the Ranges

In both panels and in each market the range is the "final" range that was in place one day before the pricing day. Nasdaq IPOs are divided into two groups: IPOs for which this range was set more than one week before the pricing date (early) and IPOs for which this range was set within one week of pricing (late).

In **Panel A**, the range center, $RCENTER$, is the midpoint between the minimum and maximum of the price range. The range size, $RSIZE$, is defined as 100(%)×(range maximum – range minimum)/range center.

In **Panel B**, Nasdaq and Neuer Markt IPOs are split into five groups: the issue price is (i)strictly above the range, (ii) at the upper bound of the range, (iii) within the range, (iv) at the lower bound of the range, and (v) strictly below the range.

Panel A: Range Center and Size

	Nasdaq			Neuer Markt
	total	early range	late range	
$RCENTER$		(US$)		(EUR)
Mean	12.85	11.69	16.25	21.64
Std.Dev.	3.75	2.20	5.07	13.01
Median	12.00	11.00	16.00	19.00
$RSIZE$		(%)		(%)
Mean	16.3	17.6	12.5	17.4
Std.Dev.	4.0	3.2	3.6	5.8
Median	16.7	18.2	11.8	16.2
No of Issues	326	243	83	117

Panel B: Distribution of Offer Prices around the Ranges

	Nasdaq			Neuer Markt
	total	early range	late range	
Issue price:	% of sample	% of sample	% of sample	% of sample
strictly above the range	50.0	42.8	71.1	0.0
at upper end of range	24.2	26.7	16.9	67.5
strictly within range	10.7	14.0	1.2	18.8
at lower end of range	8.0	8.2	7.2	11.1
strictly below the range	7.1	8.2	3.6	2.6
Total number of issues	326	243	83	117

Table 5
Summary statistics: Revision and Initial Returns

Panel A reports the price revision (PREV) for Nasdaq and Neuer Markt IPOs. PREV is defined as 100(%)×(offer price – range center)/offer price. The range is the "final" range that was in place one day before the pricing day. Nasdaq IPOs are divided into two groups: IPOs for which this range was set more than one week before the pricing date (early) and IPOs for which this range was set within one week of pricing (late).

Panel B reports the initial returns for Nasdaq and Neuer Markt IPOs. Initial return is defined as 100(%)×(closing price on the first trading day – offer price)/offer price.

Panel A: Price Revision (%)

$$PREV = 100(\%) \times (OFFER - RCENTER)/OFFER$$

	Nasdaq			Neuer Markt
	total	early range	late range	
Mean	9.1	9.0	9.6	2.8
Std.Dev.	17.2	18.9	10.6	8.5
Median	10.0	9.1	11.8	6.5
Min	-75.0	-75.0	-36.4	-27.1
Max	65.7	65.7	26.7	12.5
No of IPOs	326	243	83	117

Panel B: Initial Returns (%)

$$IR = 100(\%) \times (1stCLOSE - OFFER)/OFFER$$

	Nasdaq			Neuer Markt
	total	early range	late range	
Mean	83.5	61.0	149.3	47.5
Std.Dev.	101.0	78.1	128.8	74.3
Median	53.3	39.6	137.5	17.5
Min	-25.5	-25.5	-6.7	-30.0
Max	733.3	507.5	733.3	352.2
No of IPOs	326	243	83	117

Table 6
Variables for IPO Pricing Model

Panel A: Explanatory Variables for Underwriter Reputation, Issue(r) Characteristics, and the IPO Pricing Process prior to Range Setting

Time Notation:	
t_R	Date of the filing that sets the "final" range that is in place one day before pricing
t'_R	For IPOs with range amendments: date of the filing that sets the range before the range amendment at date t_R
t_P	Pricing date
Pricing Variables:	
$OFFER$	IPO offer price
$PREV$	$100(\%) \times (OFFER - RCENTER)/OFFER$
I_{CON}	For Neuer Markt IPOs: Dummy that equals one if OFFER equals the range maximum
$1stCLOSE$	Closing price on first day of secondary market trading
Underwriter Reputation:	
Endogenous:	
$I_{REN.UNDERWR}$	Dummy that equals one if an IPO is underwritten by a renowned bank: Neuer Markt: underwriter with Carter-Manaster ranking ≥ 7 Nasdaq: underwriter with Carter-Manaster ranking ≥ 9
$\hat{I}_{REN.UNDERWR}$	Instrument for $I_{REN.UNDERWR}$, linear combination of $I_{FSOLD<MEDIAN}$, $I_{EPROC<MEDIAN}$, $I_{EMCAP<MEDIAN}$, $ASSETS$, and variables for market conditions
Issue(r) characteristics:	
Exogenous:	
$I_{FSOLD<MEDIAN}$	Dummy variable indicating IPOs with below-median FSOLD
$I_{EPROC<MEDIAN}$	Dummy variable indicating IPOs with below-median expected proceeds
$I_{EMCAP<MEDIAN}$	Dummy variable indicating IPOs with below-median expected capitalization
$ASSETS$	Total assets of the issuer
Endogenous:	
$FSOLD$	Fraction of an issuer's outstanding shares sold in an IPO (%) (as stated in the filing at date t_R)
$\hat{F}SOLD$	Instrument for $FSOLD$: linear combination of $I_{EMCAP<MEDIAN}$, $ASSETS$, $RCENTER_{BEF}$, $FSOLD_{BEF}$, and variables for market conditions
IPO pricing process, prior to range setting:	
Exogenous:	
$RCENTER_{BEF}$	For Nasdaq IPOs with range amendments: center of the indicative price range set in the filing at date t'_R
$FSOLD_{BEF}$	For Nasdaq IPOs with range amendments: fraction of an issuer's outstanding shares to be sold in an IPO (as stated in the filing at date t'_R) (%)
$RAMEND$	For Nasdaq IPOs with range amendments: $RAMEND = (RCENTER - RCENTER_{BEF})/RCENTER_{BEF}$ Used only as a control variable for one regression in Table 10.
Endogenous:	
$RCENTER$	Center of the "final" price range in place one day before pricing
$\hat{R}CENTER$	Instrument for $RCENTER$: linear combination of $I_{EMCAP<MEDIAN}$, $ASSETS$, $RCENTER_{BEF}$, $FSOLD_{BEF}$, and variables for market conditions

Table 6, Panel B: Explanatory Variables for Primary & Secondary Market Conditions and IPO Activity

NQ stands for Nasdaq.
NM stands for Neuer Markt.

Primary and secondary market conditions:

$\bar{IR}^{NM}_{t_R-3w}$	Average initial return of NM high-tech IPOs during 3 weeks before t_R
$\bar{IR}^{NQ}_{t_R-3w}$	Average initial return of NQ high-tech IPOs during 3 weeks before t_R
$\bar{IR}^{NM}_{t'_R \to t_R}$	For NQ IPOs with range amendments: Average initial return of NM high-tech IPOs between t_R and t'_R
$\bar{IR}^{NQ}_{t'_R \to t_R}$	For NQ IPOs with range amendments: Average initial return of NQ high-tech IPOs between t_R and t'_R
$\bar{IR}^{NM}_{t_R \to t_P}$	Average initial return of NM high-tech IPOs between t_R and the pricing date t_P
$\bar{IR}^{NQ}_{t_R \to t_P}$	Average initial return of NQ high-tech IPOs between t_R and the pricing date t_P
$GREYMKT$	Percentage return from range center to pre-IPO ("grey") market price: $100(\%) \times$(last grey market price on date t_P – $RCENTER) \div OFFER$
$IX_{t_R \to t_P}$	Return on market index between t_R and the pricing date t_P NM: Neuer Markt All Share Index, NQ: Nasdaq Computer Index

IPO activity:

$N^{NM}_{t_R-3w}$	Number of NM high-tech IPOs during 3 weeks before t_R
$N^{NQ}_{t_R-3w}$	Number of NQ high-tech IPOs during 3 weeks before t_R
$N^{NM}_{t'_R \to t_R}$	For NQ IPOs with range amendments: number of NM high-tech IPOs between t_R and t'_R
$N^{NQ}_{t'_R \to t_R}$	For NQ IPOs with range amendments: number of NQ high-tech IPOs between t_R and t'_R
$N^{NM}_{t_R \to t_P}$	Number of NM high-tech IPOs between t_R and the pricing date t_P
$N^{NQ}_{t_R \to t_P}$	Number of NQ high-tech IPOs between t_R and the pricing date t_P

Table 7
Price-Range-to-Offer-Price Revision of Neuer Markt IPOs

Column (1) of **Panel A** reports Logit estimates for $I_{REN.UNDERWR}$, a dummy that equals one if an IPO is underwritten by a renowned bank with a Carter-Manaster ranking above 7. Columns (2) and (3) report SUR estimates: in column (2), the dependent variable $RCENTER$ is the center of the price range; in column (3), the dependent variable $FSOLD$ is that fraction of an issuer's stock sold in an IPO (as stated in the filing at date t_R). All right-hand-side variables are defined in Table 6. To control for the effect of market conditions we use fixed effects, characterized by the month of the first trading day, as well as four variables, $N^{NM}_{t_R-3w}$, $N^{NQ}_{t_R-3w}$, $\bar{IR}^{NM}_{t_R-3w}$, and $\bar{IR}^{NQ}_{t_R-3w}$, also defined in Table 6. Z-statistics are reported in parentheses.

Panel B reports Tobit estimates, where the dependent variable $PREV$ (price revision) is the percentage revision of the offer price from the center of the indicative price range. In the odd-numbered columns, we instrument endogenous right-hand-side variables using two-stage least squares with estimates of Panel A as the first stage. In the even-numbered columns, we include the actual values of these variables. All other right-hand-side variables are defined in Table 6. Variables with the superscript "+" equal the variables without this superscript whenever these variables take values exceeding their 75%-percentile and equal zero otherwise. In estimating these models, we assume multiplicative conditional heteroscedasticity specified by underwriter reputation interacted with the year of issue. Z-statistics are reported in parentheses.

Table 7: Panel A

	LOGIT	SUR	
Dependent Variable	Choice of renowned underwriter	Range center	Fraction sold
	$I_{REN.UNDERWR}$	$RCENTER$ (EUR)	$FSOLD$ (%)
	(1)	(2)	(3)
$I_{FSOLD<MEDIAN}$	-0.975[c]		
	(-1.84)		
$I_{EPROC<MEDIAN}$	-0.207		
	(-0.33)		
$I_{EMCAP<MEDIAN}$	-1.630[b]	-5.400[b]	5.411[a]
	(-2.13)	(-2.44)	(4.01)
$ASSETS$ (EUR, million)	-0.001	0.006[a]	0.001
	(-0.56)	(3.86)	(1.00)
Market conditions:			
$N^{NM}_{t_R-3w}$		0.373	-0.755[c]
		(0.53)	(-1.75)
$N^{NQ}_{t_R-3w}$		-0.146	0.184
		(-0.53)	(1.13)
$\bar{IR}^{NM}_{t_R-3w}$ (%)		0.026	0.016
		(0.73)	(0.75)
$\bar{IR}^{NQ}_{t_R-3w}$ (%)		0.028	0.010
		(0.59)	(0.34)
Corr. of residuals		-0.059	
p: all coeff. equal 0	0.005	0.000	0.000
R^2_{ML} / R^2	12.5%	45.5%	33.7%
No. of observations	117	117	117

[a]Significant at 1%-level. [b]Significant at 5%-level. [c]Significant at 10%-level.

Table 7: Panel B

Dependent variable: $PREV = 100(\%) \times (OFFER - RCENTER)/OFFER$

	TOBIT (1)	TOBIT (2)	TOBIT (3)	TOBIT (4)
Intercept	-21.010	26.057^{c}	17.836	-10.911^{c}
	(-0.84)	(1.75)	(1.43)	(-1.89)
Endogenous:				
$\hat{I}_{REN.UNDERWR}$	3.721		-11.300	
	(0.18)		(-1.02)	
$\hat{R}CENTER$ (EUR)	1.342^{b}		0.334	
	(2.01)		(0.74)	
$\hat{F}SOLD$ (%)	0.111		-0.631^{b}	
	(0.15)		(-2.13)	
Exogenous:				
$I_{REN.UNDERWR}$		3.715		-9.607^{a}
		(0.63)		(-4.22)
$RCENTER$ (EUR)		0.032		0.381^{a}
		(0.13)		(3.79)
$FSOLD$ (%)		-0.572		0.256
		(-1.53)		(1.42)
$I_{EPROC<MEDIAN}$	-0.932	-8.079	-4.200	-1.080
	(-0.15)	(-1.17)	(-1.42)	(-0.39)
$I_{EMCAP<MEDIAN}$	-6.234	-4.377	-3.568	-4.753
	(-0.71)	(-0.61)	(-0.65)	(-1.23)
$ASSETS$	-0.010^{b}	-0.002	-0.002	-0.003^{a}
(EUR, million)	(-2.40)	(-0.95)	(-0.83)	(-3.02)
Market conditions:				
$GREYMKT$ (%)			0.797^{a}	0.857^{a}
			(7.82)	(9.40)
$IX_{t_R \to t_P}$ (%)	1.128^{b}	0.865		
	(2.07)	(1.56)		
$IX^{+}_{t_R \to t_P}$ (%)	-2.420^{b}	-2.235^{b}		
	(-2.47)	(-2.29)		
$N^{NM}_{t_R \to t_P}$	-0.275	1.036		
	(-0.22)	(0.91)		
$N^{NQ}_{t_R \to t_P}$	-0.101	-0.553		
	(-0.17)	(-0.99)		
$\bar{IR}^{NM}_{t_R \to t_P}$ (%)	0.172	0.204^{b}		
	(1.47)	(2.03)		
$\bar{IR}^{NM+}_{t_R \to t_P}$ (%)	0.021	0.076		
	(0.14)	(0.54)		
$\bar{IR}^{NQ}_{t_R \to t_P}$(%)	0.125	0.120		
	(1.43)	(1.47)		
$\bar{IR}^{NQ+}_{t_R \to t_P}$ (%)	-0.012	-0.062		
	(-0.16)	(-0.90)		
p: zero coeff. of $IX_{t_R \to t_P} + IX^{+}_{t_R \to t_P}$	0.057	0.041		
p: zero coeff. of $\bar{IR}^{NM}_{t_R \to t_P} + \bar{IR}^{NM+}_{t_R \to t_P}$	0.033	0.012		
p: zero coeff. of $\bar{IR}^{NQ}_{t_R \to t_P} + \bar{IR}^{NQ+}_{t_R \to t_P}$	0.010	0.144		
p: coeff. of $GREYMKT$ equals 1			0.023	0.058
p: all coeff. equal 0	0.006	0.006	0.000	0.000
R^2_{ML}	34.8%	31.4%	77.3%	78.3%
No. of obs.	117	117	107	107

^{a}Significant at 1%-level. ^{b}Significant at 5%-level. ^{c}Significant at 10%-level.

Table 8
Price-Range-to-Offer-Price Revision of Nasdaq IPOs

Column (1) of **Panel A** reports Logit estimates. $I_{REN.UNDERWR}$ equals one if an IPO is underwritten by a bank with a Carter-Manaster ranking above 9. Columns (2)-(5) report SUR estimates: in columns (2) and (4), $RCENTER$ is the center of the "final" range that was in place one day before pricing; in columns (3) and (5), $FSOLD$ is the fraction of an issuer's stock sold in an IPO (as stated in the filing at date t_R). Columns (2) and (3) ((4) and (5)) report estimates for IPOs without (with) a range amendment within five weeks of pricing. Right-hand-side variables are defined in Table 6. To control for the effect of market conditions we use fixed effects, characterized by the month of the first trading day, as well as a number of other variables that are defined in Table 6. Z-statistics are reported in parentheses.

Table 8: Panel A

Sample	LOGIT All IPOs	SUR IPOs without Range Amendments		SUR IPOs with Range Amendments	
Dependent Variable	Choice of frequent underwriter $I_{REN.UNDERWR}$	Range center $RCENTER$ (USD)	Fraction sold $FSOLD$ (%)	Range center $RCENTER$ (USD)	Fraction sold $FSOLD$ (%)
	(1)	(2)	(3)	(4)	(5)
$I_{FSOLD<MEDIAN}$	0.847^a (2.71)				
$I_{EPROC<MEDIAN}$	-0.180 (-0.54)				
$I_{EMCAP<MEDIAN}$	-0.887^b (-2.31)	-0.762^b (-2.52)	8.475^a (8.74)	-2.632^a (-2.94)	1.935^b (1.99)
$ASSETS$ (USD, million)	0.010^b (2.18)	0.002 (0.55)	0.001 (0.06)	0.002 (0.41)	-0.006 (-1.07)
I_{LATE}				2.659^a (3.08)	-1.989^b (-2.11)
$RCENTER_{BEF}$ (USD)				1.017^a (7.17)	0.270^c (1.75)
$FSOLD_{BEF}$ (%)				-0.077 (-1.31)	0.781^a (12.22)
Market conditions:					
$N^{NQ}_{t_R-3w}$		0.049^c (1.91)	0.137^c (1.67)		
$N^{NM}_{t_R-3w}$		-0.005 (-0.08)	0.207 (0.99)		
$\bar{IR}^{NQ}_{t_R-3w}$ (%)		-0.006 (-1.24)	-0.015 (-1.02)		
$\bar{IR}^{NM}_{t_R-3w}$ (%)		-0.006^c (-1.83)	0.030^a (2.96)		
$N^{NQ}_{t'_R\to t_R}$				-0.160^a (-3.44)	-0.043 (-0.84)
$N^{NM}_{t'_R\to t_R}$				0.441^a (2.92)	0.201 (1.22)
$\bar{IR}^{NQ}_{t'_R\to t_R}$ (%)				-0.020 (-1.43)	-0.001 (-0.03)
$\bar{IR}^{NM}_{t'_R\to t_R}$ (%)				-0.001 (-0.02)	-0.011 (-1.27)
Corr. of res.		0.198^a		-0.062	
p: all coeff. equal 0	0.000	0.000	0.000	0.000	0.000
R^2_{ML} / R^2	18.7%	28.2%	41.5%	70.5%	80.8%
No. of observations	326	218	218	108	108

Table 8, Panel B reports Prais-Winsten FGLS estimates, where the dependent variable is $PREV$ (price revision), the percentage revision of the offer price from the center of the "final" range. In columns (1) and (2), we instrument endogenous right-hand side variables using two-stage least squares with estimates of Panel A as the first stage. Other right-hand-side variables are as defined in Table 6. Variables with the superscript "+" equal the variables without this superscript whenever these variables take values exceeding their 75%-percentile and equal zero otherwise. We allow for different coefficients if the "final" range is set "late" (within one week of pricing) or "early" (more than one week before pricing), but we estimate all of these coefficients simultaneously. We allow for heteroscedasticity across groups of IPOs underwritten by the same bank in any six months. Z-statistics are reported in parentheses.

Dependent variable: $PREV = 100(\%) \times (OFFER - RCENTER)/OFFER$

	Prais-Winsten "Final" Range		Prais-Winsten "Final" Range	
	set early (1)	set late (2)	set early (3)	set late (4)
Intercept	4.367	8.686	12.497	2.644
	(0.32)	(0.55)	(1.58)	(0.19)
Endogenous:				
$\hat{I}_{REN.UNDERWR}$	-14.123	18.376		
	(-0.61)	(1.19)		
$\hat{R}CENTER$ (USD)	-0.716	0.087		
	(-0.76)	(0.16)		
$\hat{F}SOLD$ (%)	0.206	0.404		
	(0.51)	(1.00)		
Exogenous:				
$I_{REN.UNDERWR}$			7.973[a]	1.438
			(3.58)	(0.34)
$RCENTER$ (USD)			-0.950[b]	0.355
			(-1.98)	(0.82)
$FSOLD$ (%)			-0.539[a]	0.376
			(-3.49)	(1.04)
$I_{EPROC<MEDIAN}$	1.649	-2.862	-2.040	-1.733
	(0.61)	(-0.47)	(-0.79)	(-0.29)
$I_{EMCAP<MEDIAN}$	-6.572	-4.103	5.251[c]	-4.095
	(-1.40)	(-0.60)	(1.66)	(-0.69)
$ASSETS$	0.021	-0.047	-0.009	-0.017
(USD, million)	(0.58)	(-0.82)	(-0.49)	(-0.38)
Market cond.:				
$IX_{t_R \to t_P}$ (%)	0.561[a]	0.573	0.614[a]	0.483
	(3.26)	(0.69)	(3.98)	(0.65)
$IX^{+}_{t_R \to t_P}$ (%)	-0.254	-1.347	-0.342[c]	-1.345
	(-1.27)	(-0.72)	(-1.88)	(-0.76)
$N^{NQ}_{t_R \to t_P}$	-0.091	-0.006	-0.001	-0.559
	(-0.81)	(-0.01)	(-0.00)	(-0.59)
$N^{NM}_{t_R \to t_P}$	-0.083	-1.979	-0.194	-1.531
	(-0.30)	(-0.62)	(-0.73)	(-0.53)
$I\bar{R}^{NQ}_{t_R \to t_P}$ (%)	0.184[a]	0.022	0.189[a]	0.037
	(3.15)	(0.31)	(3.41)	(0.59)
$I\bar{R}^{NQ+}_{t_R \to t_P}$ (%)	-0.105[a]	0.007	-0.093[a]	-0.003
	(-2.89)	(0.12)	(-2.63)	(-0.06)
$I\bar{R}^{NM}_{t_R \to t_P}$ (%)	0.039	-0.146	0.026	-0.096
	(0.58)	(-0.94)	(0.43)	(-0.68)
$I\bar{R}^{NM+}_{t_R \to t_P}$ (%)	0.010	0.162	0.022	0.122
	(0.16)	(1.20)	(0.38)	(0.99)
p: zero coeff. of $IX_{t_R \to t_P} + IX^{+}_{t_R \to t_P}$	0.020	0.631	0.038	0.573
p: zero coeff. of $I\bar{R}^{NQ}_{t_R \to t_P} + I\bar{R}^{NQ+}_{t_R \to t_P}$	0.040	0.389	0.008	0.283
p: zero coeff. of $I\bar{R}^{NM}_{t_R \to t_P} + I\bar{R}^{NM+}_{t_R \to t_P}$	0.022	0.716	0.016	0.546
p: all coeff. equal 0	0.000		0.000	
R^2	35.2%		41.3%	
No. of obs.	326		326	

[a]Significant at 1%-level. [b]Significant at 5%-level. [c]Significant at 10%-level.

Table 9
Initial Returns and Price-Range-to-Offer Revision of Neuer Markt IPOs

Panel A reports descriptive statistics for some right-hand-side variables of the regressions in Panel B. For IPOs priced strictly below the top of the price range, these are the actual percentage revision, $PREV = 100(\%) \times (OFFER - RCENTER)/OFFER$, the predicted price revision, $PREV_0$, estimated using the model in column (1) of Panel B of Table 7, and the surprise price revision, $SURP = PREV - PREV_0$. For IPOs priced at the top of the price range, these are $PREV_0$ (calculated as above), the latent price revision conditioned on the information contained in the grey market prices, $PREV_G$, estimated using the model in column (3) of Panel B of Table 7, the surprise price revision, $SURP_G = PREV_G - PREV_0$, and the extent of censoring, $CEXTENT = PREV_0 - MAXREV$, where $MAXREV$ denotes the percentage difference between the center and the upper bound of the range.

Panel B reports GLS estimates. The dependent variable is the initial return between the offer price and the closing price on the first trading day. Columns (1) – (2) report estimates for the variables that capture the "surprise" price revision. We test in column (3) the constraint (implied by the definition of $CEXTENT$) that the coefficients of $PREV_0$ and $MAXREV$ sum to zero. Column (4) reports estimates for the "components" of $SURP = PREV - PREV_0$ for IPOs priced strictly below the top of the price range and $SURP_G = PREV_G - PREV_0$ for IPOs priced at the top of the range. Control variables are as defined in Table 6. In estimating these models, we allow for multiplicative conditional heteroscedasticity for IPOs with an offer price censored at the top of the indicative price range. Z-statistics are reported in parentheses for robust standard errors that are more conservative than White (1980) standard errors since they are adjusted for clustering, i.e. non-independent disturbances for IPOs within the same month.

Table 9, Panel A

	38 IPOs with $OFFER <$Top of Range ($I_{CON} = 0$)			
	$SURP$	$PREV$	$PREV_0$	
Mean (%)	-11.808	-7.168	4.640	
Std.Dev. (%)	13.938	8.216	13.580	
Median (%)	-9.057	-5.334	2.764	
Min (%)	-47.359	-27.083	-26.077	
Max (%)	26.077	5.682	51.164	
	79 IPOs with $OFFER =$Top of Range ($I_{CON} = 1$)			
	$SURP_G$	$PREV_G$	$PREV_0$	$CEXTENT$
Mean (%)	38.332	62.676	24.352	20.723
Std.Dev. (%)	64.519	67.957	17.288	18.301
Median (%)	11.160	29.377	20.900	17.042
Min (%)	-49.904	-14.537	-8.190	-17.079
Max (%)	307.351	320.192	81.813	81.576

Table 9, Panel B

Dependent variable: $INITIAL\ RETURN = 100(\%) \times (1stCLOSE - OFFER)/OFFER$

	GLS (1)	GLS (2)	GLS (3)	GLS (4)
Intercept	7.987^b	29.114^a	29.082^a	28.159^a
	(2.19)	(3.09)	(3.06)	(3.32)
I_{CON}	0.578	-1.483	0.071	0.527
	(0.09)	(-0.21)	(0.01)	(0.05)
$SURP * (1 - I_{CON})$ (%) : coefficient = γ_U	0.260	0.174	0.176	
	(1.13)	(0.73)	(0.74)	
$SURP_G * I_{CON}$ (%): coefficient = γ_C	1.080^a	1.058^a	1.060^a	
	(13.12)	(10.91)	(11.07)	
$PREV * (1 - I_{CON})$ (%)				0.072
				(0.19)
$PREV_0 * (1 - I_{CON})$ (%)				-0.248
				(-0.72)
$PREV_G * I_{CON}$ (%)				1.058^a
				(10.94)
$PREV_0 * I_{CON}$ (%)			1.063^a	-1.386
			(3.00)	(-0.86)
$MAXREV * I_{CON}$ (%)			-1.438	
			(-0.98)	
$CEXTENT * I_{CON}$ (%): coefficient = δ	0.785^a	1.086^a		1.347
	(3.39)	(3.37)		(0.89)
$RCENTER$ (EUR)		-0.165	-0.171	-0.119
		(-0.79)	(-0.79)	(-0.41)
$FSOLD$ (%)		-0.487^b	-0.490^b	-0.526^b
		(-2.19)	(-2.21)	(-2.16)
$ASSETS$		0.002	0.002	0.001
(EUR, million)		(0.67)	(0.68)	(0.52)
$IX_{t_R \to t_P}$ (%)		0.739^b	0.745^b	0.759^b
		(2.08)	(2.09)	(2.03)
$N^{NM}_{t_R \to t_P}$		-1.497	-1.458	-1.473
		(-0.95)	(-0.92)	(-0.90)
$N^{NQ}_{t_R \to t_P}$		-0.091	-0.096	-0.067
		(-0.24)	(-0.26)	(-0.19)
$\bar{IR}^{NM}_{t_R \to t_P}$ (%)		-0.132	-0.130	-0.118
		(-1.50)	(-1.40)	(-1.39)
$\bar{IR}^{NQ}_{t_R \to t_P}$(%)		0.051	0.054	0.056
		(0.79)	(0.80)	(0.87)
Estimation of log(dist.variance):				
Intercept	5.651^a	5.291^a	5.289^a	5.278^a
	(12.39)	(12.44)	(12.41)	(12.42)
I_{CON}	1.584^a	1.976^a	1.980^a	1.993^a
	(3.06)	(4.10)	(4.12)	(4.17)
p: hypothesis **INFO$_U$** ($H_0: \gamma_U = 0$, $H_A: \gamma_U > 0$)	0.129	0.233	0.230	
p: hypothesis **INFO$_C$** ($H_0: \gamma_C = 1$, $H_A: \gamma_C > 1$)	0.167	0.278	0.264	
p: hypothesis **STICKY** ($H_0: \gamma_C - \gamma_U = 1$, $H_A: \gamma_C - \gamma_U \neq 1$)	0.460	0.661	0.659	
p: hypothesis **DELTA** ($H_0: \delta = 1$, $H_A: \delta \neq 1$)	0.353	0.790		0.819
p: coeff. of $PREV_0 * I_{CON}$ & $MAXREV * I_{CON}$ sum to 0			0.813	
p: coeff. of $PREV * (1 - I_{CON})$ & $PREV_0 * (1 - I_{CON})$ sum to 0				0.750
p: coeff. of $PREV_G * I_{CON}$ & $PREV_0 * I_{CON}$ sum to 0				0.838
p: all coeff. equal 0	0.000	0.000	0.000	0.000
R^2_{ML}	84.4%	85.9%	85.9%	85.9%
No. of obs.	114	114	114	114

[a]Significant at 1%-level. [b]Significant at 5%-level. [c]Significant at 10%-level.

Table 10
Initial Returns and Price-Range-to-Offer-Price Revision of Nasdaq IPOs

Panel A reports descriptive statistics for right-hand-side variables of the regressions in Panel B. $PREV = 100(\%) \times (OFFER - RCENTER)/OFFER$ is the price revision from the center of the "final" price range. $SURP$ is defined as the difference between $PREV$, and the predicted price revision, $PREV_0$, estimated using the model in columns (1) and (2) of Table 8, Panel B. We report these separately for IPOs with a final price range set "early" (more than one week before pricing) or "late" (within one week of pricing).

Panel B reports GLS estimates. The dependent variable is the initial return between the offer price and the closing price on the first trading day. Control variables are as defined in Table 6. Throughout, we allow for different coefficients and a different disturbance variance for IPOs with a final price range set "early" or "late". Z-statistics are reported in parentheses below the corresponding estimates for robust standard errors that are more conservative than White (1980) standard errors since they are adjusted for clustering i.e. non-independent disturbances for IPOs within the same month.

Table 10, Panel A

	IPOs with "final" price range set	
	early	late
SURP		
Mean (%)	0.000	0.000
Std.Dev. (%)	17.135	8.910
Median (%)	0.926	0.870
Minimum (%)	-73.884	-35.340
Maximum (%)	36.996	18.614
PREV		
Mean (%)	8.945	9.610
Std.Dev. (%)	18.927	10.639
Median (%)	9.091	11.765
Minimum (%)	-75.000	-36.364
Maximum (%)	65.714	26.667
No of Issues	243	83

Table 10, Panel B

Dependent variable: $INITIAL\ RETURN = 100(\%) \times (1stCLOSE - OFFER)/OFFER$

	GLS		GLS		GLS		
	IPOs with "final" price range set		IPOs with "final" price range set		IPOs with "final" price range set		
	early	late	early	late	early	late	late
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	60.955[a] (9.35)	149.324[a] (9.17)	103.038[a] (3.86)	89.616[b] (2.54)	94.668[a] (3.56)	111.858[a] (2.93)	129.167[a] (2.85)
$SURP$ (%): coefficient = γ_E or γ_L	2.332[a] (5.90)	5.969[a] (5.15)	2.111[a] (5.62)	5.612[a] (6.53)			
$PREV$ (%)					2.145[a] (5.63)	5.648[a] (5.40)	5.291[a] (5.00)
$RAMEND$ (%)							0.354 (0.98)
$RCENTER$ (USD)			1.308 (0.69)	8.676[a] (4.58)	1.613 (0.83)	5.745[a] (2.77)	4.267[c] (1.78)
$FSOLD$ (%)			-2.678[a] (-6.14)	-5.868[a] (-5.97)	-2.434[a] (-5.01)	-6.674[a] (-6.09)	-6.588[a] (-5.87)
$ASSETS$ (USD, million)			-0.183[a] (-3.29)	-0.196 (-0.74)	-0.187[a] (-3.16)	-0.178 (-0.66)	-0.162 (-0.60)
$IX_{t_R \to t_P}$ (%)			0.718[c] (1.79)	2.905 (0.94)	0.132 (0.33)	4.031 (1.18)	4.031 (1.22)
$N^{NQ}_{t_R \to t_P}$			-0.274 (-0.76)	1.453 (0.29)	-0.220 (-0.60)	3.172 (0.61)	3.352 (0.65)
$N^{NM}_{t_R \to t_P}$			-1.356[c] (-1.79)	4.950 (0.44)	-0.876 (-1.02)	-1.589 (-0.12)	-2.017 (-0.16)
$\bar{IR}^{NQ}_{t_R \to t_P}$ (%)			0.127 (0.74)	0.274[c] (1.72)	-0.105 (-0.62)	0.240 (1.36)	0.207 (1.15)
$\bar{IR}^{NM}_{t_R \to t_P}$(%)			0.168[b] (2.09)	0.004 (0.03)	0.074 (0.97)	-0.230 (-1.60)	-0.248 (-1.56)
p: all coeff.=0	0.000		0.000		0.000		0.000
p: hypothesis **INFO$_L$** ($H_0: \gamma_L = 0$, $H_A: \gamma_L > 0$)		0.000		0.000		0.000	0.000
p: hypothesis **INFO$_E$** ($H_0: \gamma_E = 0$, $H_A: \gamma_E > 0$)	0.000		0.000		0.000		
p: hypothesis **STICKY** ($H_0: \gamma_L - \gamma_E = 0$, $H_A: \gamma_L - \gamma_E \neq 0$)	0.002		0.000				
p: coeff. of $PREV(early)$ = coeff. of $PREV(late)$					0.001		0.002
R^2_{ML}	41.63%		54.32%		55.88%		
No. of obs.	243	83	243	83	243	83	83

[a]Significant at 1%-level. [b]Significant at 5%-level. [c] Significant at 10%-level.