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Abstract

Immediately following public offerings, underwriters often repurchase shares of poorly performing IPOs in an apparent attempt to stabilize the price. Using proprietary Nasdaq data for a large sample of IPOs, I study the price effects and cross-sectional determinants of price support. Some of the key findings are: (1) Price stabilization is substantial, inducing significant price rigidity at and below the offer price. Stabilization appears, at least in the short run, to raise the equilibrium stock price. (2) Many studies suggest that stabilization helps to mitigate information asymmetry problems in the IPO market. I find no evidence that stocks with larger ex-ante information asymmetries are stabilized more strongly. (3) The characteristics of the lead underwriter emerge as the strongest determinants of price support. Larger and more reputable investment banks stabilize more, perhaps to protect their reputations with investors. But there are substantial differences in price support even among the largest underwriters (after controlling for IPO characteristics and underwriter size). (4) Investment banks with retail brokerage operations stabilize much more than other large investment banks. This puzzling result seems inconsistent with the common view that stabilization benefits primarily institutional investors, and I outline and examine several alternative explanations.

1 Introduction

The initial public offering is a critical step for young entrepreneurial firms, providing access to the public equity market for the first time. Because of this important role, a large literature studies the functioning of the IPO market. Researchers have noted, in particular, two important features of the pricing process: (i) underwriters systematically underprice IPOs, and (ii) immediately following the offering, underwriters often repurchase shares of poorly performing IPOs in an apparent attempt to stabilize the price. The second phenomenon – price support – has received comparatively little attention (I review the literature below) even though price support is important to investors and may have an indirect effect on underpricing.

This paper extends the empirical literature on price support along two dimensions. First, I investigate the price and volume effects of stabilization for a large sample of IPOs using proprietary transaction data obtained from Nasdaq. Second, the large-sample data provide a unique opportunity to study the cross-sectional determinants of price support. The goal is to better understand what factors influence an underwriter's decision to stabilize an IPO. The analysis also sheds light on some previously suggested explanations for price support that have not been, as yet, empirically examined.

The literature offers several explanations for price support. A common perspective is that price support, like underpricing, helps mitigate adverse selection problems in the IPO market. Benveniste, Busaba, and Wilhelm (BBW 1996) argue that stabilization is a put option given to institutional investors as a reward for revealing private information during the pre-offering period. Chowdry and Nanda (CN 1996) suggest, instead, that the put option compensates *uninformed* investors for the "winner's curse," in the spirit of Rock (1986). Alternatively, Hanley, Kumar, and Seguin (1993) suggest that price support allows underwriters to disguise overpriced offerings from investors by temporarily inflating the stock price. Schultz and Zaman (1994) argue that stabilization increases the stock price permanently by reducing the supply of shares, and thereby helps to distribute overpriced shares to initial investors.

One difficulty with testing these ideas is that underwriters do not formally commit to price support, nor do they publicly disclose stabilizing activities. Hence, little information on price support is available from public sources. This paper uses proprietary transaction data for a large sample of Nasdaq IPOs. The data identifies, for every trade, the type of each trading party (e.g., whether it is a marketmaker or a broker trading on behalf of a customer) and indicates which party is buying and which is selling. This allows me to track investor selling activity for 20 days after the offering. Using this information, I construct measures of price support based on the underwriter's inventory

accumulation, the "stickiness" of the bid (i.e., the extent to which the bid reacts to selling pressure), and the closeness of the bid to the offer price.

I start by documenting how price support affects prices and trading volume in the aftermarket. Similar to Ellis, Michaelly, and O'Hara (2000) and Aggarwal (2000), I find that underwriters accumulate large inventories of cold IPOs on the first trading day, consistent with price support. Stock prices are extremely rigid at and below the offer price, in the sense that it requires large selling pressure to induce a price decline. For example, if a stock opens the first day at the offer price, marketmakers repurchase, on average, 6.0% of shares offered before they allow the bid to drop. The corresponding number is 2.1% for IPOs that open below the offer price, and only 0.4% for stocks that open above the offer price. The unusual bid rigidity at and below the offer price suggests that underwriters are willing to repurchase cold IPOs at inflated prices.

Interestingly, there is little evidence that stock prices decline after stabilization is withdrawn. Thus, stabilization seems to have a long-lasting effect on prices. Further, there are a disproportionate number of stocks for which the bid price remains exactly at the offer price for several days after the IPO, in spite of strong selling pressure on day one. These patterns are consistent with a downward-sloping demand curve for IPOs. Alternatively, it is possible that underwriters have private information about the stabilized stocks and repurchase only IPOs that, they believe, are either undervalued or fairly valued.

In the second part of the paper, I investigate how price support varies across stocks. I begin by examining several predictions suggested by CN and BBW. As mentioned earlier, both papers argue that stabilization helps mitigate information asymmetries in the IPO market and, in that sense, is a substitute to underpricing. A natural empirical implication is that, other things equal, stocks with more information asymmetries should exhibit more underpricing or stronger price support. I do not find support for this hypothesis. Instead, price support appears strongest for IPOs that are *less* risky, i.e., that are larger and have lower gross spreads, and for IPOs underwritten by larger, more reputable underwriters. A story that is consistent with these findings is that underwriters avoid stabilizing risky IPOs, but that large underwriters can absorb inventory risk better and, hence, stabilize more strongly. However, Aggarwal (2000) finds that underwriters usually oversell the issue and begin the first trading day with a short position.[1] Therefore, it is not clear how important risk considerations are in

[1] If the IPO performs poorly in the aftermarket, underwriters use the repurchased shares to cover the short position. If the IPO performs well, underwriters can exercise the over-allotment option and cover the short position by purchasing additional shares from the issuer.

practice because underwriters can implicitly hedge inventory risk. Alternatively, large underwriters may be more willing to support overpriced IPOs to protect their reputation with investors. Similarly, only reputable underwriters are able to credibly commit to price support at the time of the offering. Consistent with the reputation hypothesis, I find that underwriters stabilize less extensively on days when the stock market is doing poorly, i.e., when the weak IPO performance can be attributed to market-wide events outside underwriter's control.

Although IPO risk and underwriter size are important in explaining price support, a closer look at the data suggests that they are not the full story. Replacing the underwriter-size measure by underwriter fixed effects substantially increases the adjusted R-squared in the price-support regression. The underwriter fixed effects are economically very significant. For example, ranking top-20 investment banks by price support, "Bank 3" accumulates, on average, 25% of shares offered on day one for IPOs that close at or below the offer price, but "Bank 18" accumulates only 2.6% of shares offered. This difference is significant at a 1% level, even after controlling for IPO characteristics. Thus, it appears that underwriters' heterogeneity, unrelated to size and reputation, is a major determinant of price support. This result is difficult to reconcile with the existing stabilization models, and it raises the question what investment bank characteristics are responsible for the large differences in price support.

To explore this question, I examine several key characteristics of large investment banks. The type of an investment bank's client base emerges as one of the most important determinants of price support. Aggarwal (2003) shows that banks with significant retail brokerage operations distribute a higher fraction of IPO shares to retail investors. I find strong evidence that these "retail" banks are more committed to stabilization than other top-20 investment banks. After controlling for underwriter size and IPO characteristics, retail banks repurchase 10.6% of shares offered more on day one (for cold IPOs) than other top-20 investment banks. This result is surprising. Evidence in prior studies suggests that price support benefits mostly large institutional traders: empirically, institutions are more likely to take advantage of stabilization by flipping cold IPOs (Benveniste, Erdal, and Wilhelm, 1998; Aggarwal, 2003). At face value, this seems inconsistent with stronger price support by retail banks.

I suggest three explanations for the results. First, retail banks might value price support because it allows them to discriminate among investors: a promise to repurchase weak IPOs can be targeted to specific investors. Second, Hanley et al. (1993) suggest that underwriters support prices to disguise weak offerings from initial investors. If such tactics indeed take place, they are probably targeted at unsophisticated investors, and therefore may be favored by retail banks. Third, it is possible that

retail banks suffer larger reputation damage from ex-post overpriced IPOs (Section 5.4.2 discusses this idea in detail.) This hypothesis is consistent with retail banks using price support more extensively to protect their reputations with investors. To examine these hypotheses, I study the behavior of retail and institutional investors in the aftermarket using transaction size as a proxy for investor type. I find little evidence that retail banks temporarily inflate prices to confuse unsophisticated investors, and the overall evidence is more consistent with the reputation and discriminatory motives for price support.

This paper extends the empirical literature on price support. Most studies focus on the price effects of stabilization, using indirect measures. Ruud (1993) shows that the distribution of initial returns is nearly censored at zero, which suggests that underwriters stabilize IPOs at the offer price. Schultz and Zaman (1994) find that underwriters are significantly more active on the inside bid for overpriced issues than for underpriced issues, consistent with underwriters making stabilizing bids for cold IPOs. Hanley et al. (1993) show that stocks which close near the offer price on day one subsequently decline and their bid-ask spreads subsequently widen, consistent with prices adjusting to equilibrium after withdrawal of price support. (My tests provide contradictory evidence.) More recently, Aggarwal (2000) describes how price support is performed on Nasdaq. She shows, for example, that underwriters almost never disclose stabilizing bids to the market participants, and that they start the first trading day with large short positions in the IPO stock. Ellis et al. (2000) estimate underwriters' profits from aftermarket trading and explore underwriters' aftermarket activities. Prabhala and Puri (1999) examine cross-sectional variation in price support. They test a different set of predictions and, because they only have publicly available data, use a less precise measure of stabilization than the current paper. Boehmer and Fishe (2002) compare underwriter's short-covering transactions for a sample of IPOs and a sample seasoned equity offerings (SEOs). They show that the extent of short-covering transactions is positively associated with selling pressure for IPOs but not for SEOs.

The paper is organized as follows. Section 2 discusses models of price support. Section 3 describes the data and the sample. Section 4 presents the intraday analysis. The cross-sectional tests are discussed in Section 5. Section 6 concludes.

2 Motives for price support

The literature offers several different explanations for price support, which I briefly summarize in this section. Section 2.3 suggests an alternative perspective on price support that emphasizes the role of the underwriter's reputation.

2.1 Price support as a reward to investors and a bonding mechanism

CN build on Rock's (1986) model of underpricing, arguing that stabilization provides an alternative way to compensate uninformed investors for the winner's curse. A commitment to repurchase shares at the offer price is equivalent to giving a put option to investors. The put option is valuable after the offering if the market price is lower than the offer price. Since uninformed investors are more likely to end up with overpriced stocks, they value the put option, at the time of the offering, more than informed investors. Thus, CN argue that stabilization may be more efficient than underpricing in compensating uninformed investors for adverse selection costs.

BBW model the pre-offering stage of the issuing process, during which investors submit "indications of interest" to the underwriter. The underwriter uses this information to determine IPO allocations and the offer price. Informed investors have no incentive to disclose high interest, since this causes the underwriter to raise the offer price. Therefore, the underwriter rewards investors who convey good information with higher allocations of underpriced stocks (see also Benveniste and Spindt, 1989). Stabilization provides an alternative way to reward informed investors for submitting truthful indications of interests. Further, the commitment to repurchase shares in the aftermarket at the offer price bonds underwriters against deliberate overpricing.

Similar to CN and BBW, Prabhala and Puri (1999) consider stabilization as an explicit commitment by the underwriter to repurchase IPO shares in the aftermarket at the offer price. Stabilization makes the IPO process more efficient because it encourages the underwriter to produce more information about the IPO before the offering (lower uncertainty about the IPO value makes the put option less valuable). The additional information reduces adverse selection problems at the offering stage and improves liquidity in the aftermarket.

2.2 Price support as form of price manipulation

Hanley et al. (1993) suggest that stabilization temporarily inflates the stock price and allows underwriters to disguise overpriced offerings. They argue that "if a price drop [after IPO] is apportioned over a number of days, the perception of overpricing may be obscured by intervening market moves or informational shocks, thus concealing the overpricing from the underwriter's clients (both investors and issuers)." Although this argument has not been further explored, it seems unlikely that underwriters could easily deceive issuers and sophisticated investors who can infer price support from price and trading patterns. However, it is possible that underwriters try to disguise weak issues from individual investors, perhaps to encourage retail demand in future offerings. A related reason for price manipulation would arise if unsophisticated investors engage in positive-feedback

trading after the IPO.[2] By disguising the weakest IPOs from these investors, underwriters could mitigate price pressure caused by momentum traders.

Schultz and Zaman (1994) suggest that the purpose of price support is to *permanently* increase the aftermarket stock price. They argue that this is necessary for cold IPOs to assure an efficient share distribution in the primary market. They point out that, because of settlement delays, investors can renege on their offers to buy the initial allocations during the first few days after the stock begins trading. The investors have an incentive to do so if the IPO trades below the offer price because they can purchase the stock at a lower price in the aftermarket than in the primary market. To prevent a "cascade" of offer withdrawals, the underwriter promises to repurchase shares in the aftermarket at the offer price. This strategy is successful because underwriters are able to permanently affect the market price by reducing the supply of IPO shares. Finally, Fishe (2001) argues that underwriters choose the offer price, the over-allotment, and the degree of price support to maximize their profits from the offering, including the profits from the aftermarket trading.

2.3 Price support and underwriter reputation

This section puts forward an alternative motive for price support that has received less attention in prior literature (although related ideas appear in Hanley et al. (1993), BBW, and Prabhala and Puri (1999)). I argue that underwriters choose, ex post, to support weak IPOs to protect their reputations with investors. Many authors emphasize the importance of underwriter reputation.[3] Underwriters are third-party intermediaries who produce information about new issues and certify the issue price. Underwriter's reputation mitigates incentive problems that arise in this certification process. Investors infer an underwriter's ability, effort, and honesty by observing his past performance. Incidents of overpricing hurt underwriter's reputation and decrease future underwriting revenues. Consistent with this story, Beatty and Ritter (1986) and Dunbar (2000) show that investment banks that price IPOs inaccurately subsequently loose market share. Similarly, Nanda and Yun (1997)

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[2] Barry and Jennings (1993) and Affleck-Graves, Hedge, and Miller (1996) document short-term price continuation after IPOs that is consistent with momentum trading. Also, several anecdotal accounts of momentum trading appear in the financial press. For example Prial (1997) writes in a Wall Street Journal article: "The main reason new internet issues are so volatile is because retail investors who are buying in the aftermarket … tend to buy the stock rather than the company. In other words, traditional research methods have been thrown out the window in favor of momentum buying. If a stock is moving up, buy it. If it's skidding, sell it." In another Wall Street Journal article, Lucchetti (1999) writes "the rules of the game have changed. It's impossible to discover price in a world where a bunch of anonymous small orders drive the market."

[3] Some examples are: Beatty and Ritter (1986), Booth and Smith (1986), Carter and Manaster (1990), and Chemmanur and Fulghieri (1994).

document that overpriced offerings are associated with subsequent declines in the underwriter's market value.

It seems interesting to consider the role of price support in this context. Underwriters face uncertainty about the IPO value when they set the offer price. Thus, even honest and competent banks can make mistakes and overprice their IPOs. Such mistakes are probably difficult to distinguish from incompetence, negligence, or even deliberate overpricing. By supporting a weak IPO, an underwriter can reduce losses to investors in situations when the IPO proves, ex post, to be overpriced. Moreover, the bank's willingness to support an issue can signal to investors that it acted in good faith at the offering. In short, price support can be viewed as an ex-post action aimed at protecting underwriter's reputation with investors.[4]

3 Sample, data, and descriptive statistics

3.1 Sample selection

The paper examines 1,422 firm commitment IPOs issued on Nasdaq from 1996 through 1999. The availability of proprietary transaction data restricts the sample to this four-year period and to Nasdaq IPOs. I begin with a sample of all IPOs in the Securities Data Company (SDC) new issues database that went public from January 1996 through December 1999. I exclude all non-original IPOs, unit issues, and spin-offs, which leaves 2,095 IPOs. From this sample, I keep 1,690 stocks listed (according to the SDC) on the Nasdaq National Market or on the SmallCap Market, of which I obtain Nasdaq trading and quote data for 1,511. Further, I require that the IPO-related variables (e.g., the offer price and the number of shares offered) are available on SDC, which reduces the sample to 1,422 IPOs. Because the paper focuses on price support, some tests use a smaller sample of 280 "cold" IPOs with negative or zero initial returns. Some cross-sectional tests use publicly available information from the lead underwriter's financial statements. For these tests, I construct a smaller sample of 738 IPOs (122 cold IPOs) underwritten by the top-20 lead underwriters. The lead underwriters are ranked based on the aggregate proceeds of all IPOs taken public in the 1990s.

[4] An interesting question is why underwriters do not *explicitly* commit to price support but, instead, decide ex post whether (and how much) to stabilize. One could argue that an explicit commitment could be both technically enforceable and more effective in binding the underwriter against overpricing. However, even the best legally binding contract could be too costly to enforce. It may have to specify precisely under what conditions underwriter provides price support, how many shares are repurchased, at what prices, over what time period, etc. Moreover, it could be efficient to leave underwriter some discretion in the choice of price support if he is better informed about the costs and effects of price support than investors.

3.2 Data

Transaction data were provided by the NASD Economic Research Department. The dataset contains transaction time, price, and volume for each trade during the 20 trading days following the IPO. In addition, the dataset contains variables that identify each trading party as either a market-maker or an order-entry firm and an indicator that identifies who is buying and who is selling. An order-entry firm is usually a broker trading on behalf of a customer. This information allows me to track marketmakers' total inventory accumulation for each IPO. For example, if a marketmaker buys 1,000 shares from an order-entry firm, then I know that aggregate marketmakers' inventory increases by 1,000 shares. Trades between two marketmakers or two order-entry firms have no impact on marketmakers' total inventory.

The dataset is similar to the smaller sample used by Ellis et al. (2000), except that I do not know the precise identities of the trading parties. Consequently, I can compute only the aggregate marketmakers' inventories rather than, as in their paper, the inventories of the lead underwriter. The evidence in Ellis et al. suggests that this aggregate measure is a very good approximation of the *underwriter's* inventory because the lead underwriter is always a marketmaker of the IPO stock and, more importantly, his activity accounts for the lion's share of marketmakers' total inventory position in the stock. In their sample, the lead underwriter accounts for approximately 80% of marketmakers' inventory accumulation on day one. Although Ellis et al. do not provide this information separately for cold and hot IPOs, I expect that the lead underwriter's share is substantially higher for cold IPOs because of price stabilization.

The IPO-related variables, e.g., the offer price, offer date, number of shares offered etc., come from SDC. I use the CRSP daily stock files to estimate the aftermarket return volatility for each IPO. I collect financial statement information concerning the top investment banks from 10-K filings and annual reports for fiscal year 1999 or for the last fiscal year in which the bank appears in the sample. Information on mutual funds managed by each investment bank comes from the CRSP Mutual Funds Database. Because the sample period includes the internet bubble of late 1990s, I control for internet IPOs in the all regressions. To identify internet stocks, I use the classification described in Demers and Lewellen (2002). Their classification relies on the Morgan Stanley Dean Witter *Technology and Internet IPO Yearbook (6th ed.)* and on InternetStockList™ provided by internet.com at http://www.internetnews.com/stocks/list/.

3.3 Descriptive statistics

Table 1 reports characteristics of the 1,442 sample firms; Table 2 describes how these characteristics change during the four-year sample period. The tables present separately a sub-sample of 738 IPOs taken public by the top-20 underwriters, discussed in more detail in Section 5. The average firm in the total sample raised $49.4 million in total proceeds (median of $35.0 million) and experienced an initial return of 31% (median of 13%). Table 2 shows that both of these figures increased during the sample period, and that the strongest increase occurred in year 1999. For example, the average initial return went from 18% in 1996 to 24% in 1998 and to 73% in 1999. This shift was accompanied by an increase in the number of internet IPOs from 5% of the sample in 1996 to 61% in 1999. Table 2 also shows, interestingly, that there is a significant increase in the average rank of the lead underwriter (from 2.2 to 5.5) and in the average syndicate size (from 2.2 to 3.4 members) during the sample period.

Tables 1 and 2 document substantial differences between the total sample and the sub-sample of 280 cold IPOs with zero or negative initial returns. The cold IPOs have, on average, significantly lower proceeds and higher gross spreads. Also, they tend to be underwritten by less reputable underwriters and are less frequently backed by venture capital. All these differences are significant at a 1% level.[5] Also, Table 1 shows that marketmakers accumulate significantly higher inventories of cold IPOs than hot IPOs on day one. The mean accumulation for cold IPOs is 9.0% of shares offered compared with 1.6% of share offered for the total sample. This difference is consistent with the presence of price support.

4 Price and volume effects of price support

In this section, I examine the intraday behavior of prices and volume following IPOs. The goal is to understand how underwriters support prices in the aftermarket and how stabilization affects prices and trading volume. In addition, the evidence helps identify stabilized stocks and suggests several measures of stabilization for the cross-sectional tests. The intraday analysis focuses on several questions: At what prices do underwriters stabilize IPOs? Is the promise to repurchase shares *at the offer price* an important part of the stabilization commitment? Do underwriters adjust the level of stabilization to reflect trading imbalances and information during the stabilization period? What is

[5] One potential explanation for these differences is that riskier IPOs, i.e., those that are more difficult to price, are more likely to experience extreme initial returns, and, therefore, more likely to end up in the left tail of the initial return distribution. Based on prior studies, riskier IPOs tend to be smaller, have higher gross spreads and are associated with less reputable underwriters.

the magnitude and the duration of price support? How do stock prices adjust after withdrawal of price support?

4.1 Measures of price support

I define price stabilization as share purchases made by the underwriter that are designed to increase the aftermarket stock price. This definition emphasizes the underwriter's *intent* to influence the stock price. Since the underwriter's intent cannot be observed, it is impossible to precisely identify stabilized stocks or to perfectly measure the degree of stabilization. In this section, I explore three measures of price support based on the patterns in stock price behavior and volume which are likely to reflect price support.

Stabilization means that the underwriter offers to repurchase shares at an inflated price. The offer is likely to induce selling pressure as investors take advantage of the artificially high price. Consequently, stabilized stocks should exhibit an unusually high selling volume from investors to the underwriting syndicate. This suggests the first measure of price support: the change in marketmakers' inventory position of the IPO stock after the offering. (In the following, I refer to this measure as "marketmakers' inventory accumulation" or "investors' net sales".) This measure is similar to that used in Ellis et al. (2000). Based on their evidence, the change in *marketmakers'* inventory position is a good proxy for the change in the *syndicate's* position because the syndicate members, in particular the lead underwriter, account for most of marketmakers' trading in the IPO aftermarket.

The underwriter might respond in two ways to the selling pressure that accompanies price support. One possibility, often assumed in the literature, is that the underwriter maintains the bid at a particular level, typically the offer price, throughout the stabilization period. As an alternative, the underwriter might partially respond to the selling pressure by periodically revising the level of price support. In either scenario, selling pressure accompanied by a "stickiness" of the stock price seems consistent with price support. Thus, the second proxy for price support tries to capture the degree of price stickiness on the first trading day. For each stock, I compute the average change in marketmakers' inventory that precedes each downward bid revision on day one. The inventory change is measured starting from the previous bid revision. This quantity should measure the degree of investors' selling pressure needed to induce a marketmaker to lower the inside bid.

Finally, the third measure of price support is motivated by Ruud (1993) and Prabhala and Puri (1999). They document that the distribution of initial returns is almost censored at zero with an unusually low probability of negative returns. Both studies suggest that these patterns are caused by

stabilizing transactions aimed at preventing the market price from dropping below the offer price. If this objective is important, stabilized stocks should exhibit an unusually high frequency of trades (sales from investors to the underwriting syndicate) executed at the offer price. Thus, my third proxy for stabilization measures the frequency of trades on day one occurring exactly at the bid equal to the offer price.

Each of the three measures captures a somewhat different aspect of price support. Together, the variables should provide a good description of the behavior of stabilized stocks, but each variable is an imperfect proxy. For example, even though high selling pressure and price stickiness is consistent with price support, a similar pattern could also occur, at least in principle, for poorly performing stocks that are not stabilized. Aggarwal (2000) finds that underwriters begin the first trading day with large short positions in IPO stocks. They usually have an option to cover the short position by purchasing an additional 15% of shares offered from the issuer (the overallotment option). However, if a stock trades sufficiently below the offer price, at a discount larger than the gross spread, the underwriter would prefer to cover the short position by repurchasing shares in the aftermarket. Such repurchases do not unambiguously reveal underwriter's *intention* to support an issue, although they may affect the market price and trading behavior in a similar way. Therefore, the empirical tests attempt to control for these repurchases.[6]

4.2 Price support on the first day after IPO

Trading at the offer price. I start by examining the third measure of price support, the frequency of trading at the offer price. If underwriters commit to stabilize stocks *at the offer price*, we should observe an unusual frequency of trades, mostly investors' sales, at this price level. Figure 1 shows the distribution of trades executed at a particular level of the bid, with bid levels measured in number of ticks ($0.125) above the offer price. More precisely, I compute for each stock the fraction of trades executed at each bid level; then, I average the fractions across stocks. The figure shows an extreme spike at zero that is consistent with stabilization at the offer price. For an average stock, 9.4% of trades on day one occur exactly at the bid equal to the offer price. For most other bid levels, the average frequency does not exceed 1%. Moreover, the distribution is asymmetric in the neighborhood of zero with relatively low frequencies for negative bid levels. This pattern is consistent with price support inflating prices of overpriced stocks.

[6] Alternatively, one could argue that underwriters oversell an issue *because* they intend to support the price if the stock performs poorly in the aftermarket. Under this assumption, the existence of a short position itself reveals the intention to stabilize.

Inventory accumulation. Table 3 and Figure 2a show underwriter's inventory accumulation for four groups of stocks classified by under- or overpricing. I look separately at stocks trading at the offer price because Figure 1 suggests that these stocks are stabilized most strongly. I also separate a group of stocks that trade in the range of –7% – 0% below the offer price because in this range, underwriter's buying is most likely motivated by the intention to support prices. If underwriter's objective was only to cover his short position, he could do so by purchasing up to 15% of shares offered from the issuer at a discount from the offer price of approximately 7%. (In my sample, 263 out of 280 overpriced stocks have a gross spread of 7% or higher.) Finally, I assume that no stabilization is needed for stocks trading above the offer price, which allows me to use these stocks as a benchmark sample.

In Panel A of Table 3, stocks are assigned to one of the four groups if at least 70% of trades on day one occur within a given price range; in Panel B stocks are classified based on the opening return. Generally, the table shows strong inventory accumulation for all groups of overpriced IPOs and almost no accumulation for underpriced IPOs, consistent with price support. Interestingly, there is no evidence that price support is strongest at the offer price, which is surprising given the evidence in Figure 1. Stocks that trade at least 70% of times at the offer price exhibit first-day inventory accumulation of 4.3% of shares offered, compared to 13.4% for stocks trading within the –7% – 0% range. These estimates might be biased towards finding high investor selling for stocks trading at low prices because selling pressure might have *caused* the price decline. However, even when the classification is based on the opening return (measured by first bid), net selling remains strongest for firms in the –7% – 0% range.

The proprietary database used in this paper provides a direct measure of investors' net selling volume. Since it is not possible to identify buys and sales using publicly available data, many previous studies use trading imbalances estimated using the Lee and Ready (LR, 1991) algorithm.[7] For comparison, the right panel of Table 3 reports the estimates for my sample. The trading imbalance substantially overstates investors' net selling volume, sometimes by factor two or more. Further, the bias varies strongly across cold and hot IPOs. This is important because studies that use the LR algorithm to identify net selling often make comparisons across these groups of stocks. I find that the discrepancy is caused, to a large extent, by inter-dealer trades that occur more frequently at the bid than at the ask.

Price stickiness. Figure 1 documented price rigidity at the offer price. Panels C and D in Table 3 and Figure 2b show a second measure of price stickiness: the average net selling volume preceding a downward bid adjustment for various starting levels of the bid. (The net selling volume is computed beginning at the previous bid adjustment.) The results confirm that underwriters are reluctant to lower the bid below the offer price. On average, marketmakers accumulate 3.31% of shares offered before they are willing to lower the bid if it is currently at the offer price. No comparable rigidity can be observed at any other bid level. The estimate of 0.18% of shares offered for the bid between –7% and 0% seems low compared to the offer price. However, it is still substantially higher than for the benchmark sample of underpriced stocks (-0.02% of shares offered), and the difference is statistically significant at a 1% level. These relatively slow bid adjustments observed in the sub-sample of overpriced IPOs are consistent with price support.

4.3 When do underwriters withdraw price support?

Figure 3a documents the average marketmakers' inventory accumulation during the first 20 days following the IPO for under- and overpriced stocks. The figure confirms previous evidence in Ellis et al. (2000) and Aggarwal (2000) that the strongest share repurchases of cold IPOs, presumably by the lead underwriter, take place on the first trading day but that additional inventory build-up continues during the following three weeks. Figure 3b presents more detailed evidence on the timing of marketmakers' repurchases. Interestingly, the figure shows that an extremely high fraction of net repurchases takes place during the *first few minutes* of trading. For example, for stocks opening below the offer price, the first five minutes accounts for 55% of total inventory accumulation on day one and first ten minutes accounts for 66%.

Table 4 documents in more detail how the withdrawal of price support occurs. The table shows the timing of subsequent bid decreases for stocks that experience a monotonic bid decline starting from the beginning of trading on day one. I measure timing in two ways: first, I compute the average number of days after the IPO on which each subsequent bid decrease occurs; second, I compute the average inventory accumulation and trading imbalance before each bid decrease. Panel B reports the same statistics for bid increases. The table reveals several interesting patterns. First, underwriters appear to adjust the stabilizing bid gradually to selling pressure rather than withdraw it completely at one point of time: selling pressure tends to decline after each subsequent bid decrease. Second, the

[7] Roughly speaking, the algorithm classifies trades as buyer- or seller-initiated based on whether they occur closer to the bid or ask (see Lee and Ready, 1991, for details). Trading imbalance is then seller-initiated trading volume minus buyer-initiated trading volume.

strongest investors' sales occur at the *first bid* quoted when the trading begins on day one, which is consistent with the evidence in Figure 3b. For stocks that open at the offer price, marketmakers accumulate on average 6.0% of shares offered before the bid drops for the first time. The inventory accumulation between the first and the second bid decrease is only 0.9% of shares offered. (The corresponding numbers are 2.1% and 1.3% for stocks that open below the offer price.) Third, it takes, on average, a long time (measured in the number of days) before the underwriter allows the bid to drop below the offer price. For an average stock that opens at the offer and subsequently declines, the first bid decrease occurs on *day three* after IPO.

4.4 Do prices decline after stabilization ends?

This section investigates the price effects of stabilization. In principle, the analysis provides direct evidence on how strongly underwriters inflate prices during the stabilization period: if stabilization affects prices temporarily, prices should adjust to their equilibrium levels after withdrawal of support. It is also possible, however, that stabilization has a long-lasting or even permanent effect on prices. If demand curves for IPO stock are downward sloping, perhaps because investors do not rationally learn from prices, then we should observe little or no price adjustments following the withdrawal of price support. Also, underwriters might have private information about the IPO and repurchase only those stocks that they consider to be undervalued. In this case, stabilization might be associated with zero or even positive subsequent returns.

The analysis of returns is complicated by a puzzling phenomenon. Barry and Jennings (1993) find short-term price continuation for over- *and* underpriced IPOs. This phenomenon is not necessarily related to price support. The tests below attempt to control for continuation unrelated to price support.

Table 5 presents cumulative Nasdaq-adjusted returns for 20 trading days after IPO for groups of stocks sorted based on the level of the closing bid on day one and based on the inventory accumulation on day one. The results confirm previous evidence on short-term price momentum for Nasdaq IPOs. Stocks with the closing bid above the offer price earn a cumulative return of 1.1% during the first 10 days after IPO and 6.4% during the first 20 days. The estimates are –4.8% and –0.04%, respectively, for stocks with negative initial returns. (The differences between the two groups of stocks are statistically significant for 19 out 20 trading days.) Several authors attribute the price decline for cold IPOs to the withdrawal of stabilization. Unfortunately, this conjecture is less convincing given the anomalous price continuation of both under- and overpriced IPOs.

To shed light on these issues, Table 5 compares the returns for stocks with above- and below-median inventory accumulation on day one for each sub-sample. If stabilization affects prices temporarily, we should observe a negative association between net selling volume and the subsequent price adjustment. The evidence in Table 5 does not support this conjecture. Overpriced stocks that appear less stabilized, i.e. have below median net selling volume on day one, experience significantly *stronger* price declines starting after IPO than overpriced stocks with above-median net selling. There is some evidence of temporary price effects for stocks that close the first trading day at the offer price. For this group, stocks with above average inventory accumulation on day one experience a significantly stronger price decline starting on day two. However, it is not clear if this price decline is caused by price support: the last three columns in Table 5 show that underpriced stocks, which are probably not stabilized, exhibit a similar pattern. Also, the poor performance reverses to some extent after day 10. Overall, the evidence suggests that stabilization has a mostly permanent effect on price. Alternatively, underwriters stabilize stocks that they consider close to fairly valued.

4.5 Summary

The analysis above reveals several interesting patterns. (1) Marketmakers purchase large fractions of cold IPOs at and below the offer price, which is consistent with price support. (2) Stock prices are extremely sticky at the offer price in the sense that it requires large selling pressure to move the bid. This suggests that underwriters commit to repurchase shares *at the offer price*. (3) More than 50% of the first-day net selling volume for cold IPOs occurs during the first five minutes of trading, often before the first bid adjustment. After that, stabilization is withdrawn gradually with selling pressure declining slowly after subsequent bid decreases. (4) There is no evidence that prices decline more after stabilization is withdrawn, so price support appears to have a permanent effect on prices.

5 Determinants of price support

Price support appears to significantly affect prices and trading in the aftermarket. The analysis also indicates large variation in the degree of price support across stocks. This section investigates the cross-sectional determinants of price support. Section 5.1 describes the tests and Sections 5.2 and 5.3 discuss hypotheses and results.

5.1 Measuring price support

The purpose of the cross-sectional analysis is to test how underwriters' *ex ante* commitment to stabilize varies across stocks. Unfortunately, the commitment is not directly observable, and inferences must be based on the *ex post* observed stabilization. Stabilization will not be observed for stocks that trade above the offer price, but this does not mean the underwriter did not commit to stabilize them had the price declined. Therefore, I limit the sample to overpriced IPOs so that price support can potentially be observed.

I use two measures of price support introduced in Section 4. The reported regressions use the marketmakers' inventory accumulation on the first trading day. The idea is that stabilized stocks should exhibit larger selling pressure as investors take advantage of the inflated price. The more the stabilizing bid deviates from the equilibrium market price, the more investors are probably willing to take advantage of stabilization. An alternative measure is based on the idea that, if stabilization is aimed at preventing a price decline, bid prices of stabilized stocks should respond less frequently to trading imbalances than bid prices of non-stabilized stocks. The extreme bid persistence at the offer price, documented in Table 3, supports this assumption. Thus, a second measure of price support is the average net selling volume that precedes a bid adjustment on day one (like the analysis is Table 3). The results presented in the following sections are generally consistent across these two measures, and footnote 16 compares the results in more detail.[8]

5.2 IPO risk, information asymmetries, and underwriter reputation

CN and BBW argue that stabilization and underpricing mitigate information asymmetry problems in the IPO market. A natural empirical prediction is that, other things equal, stocks with larger information asymmetries should experience larger underpricing and/or more price support. Information asymmetries arise when some market participants have better information about the stock's value than other investors. The degree of information asymmetry is difficult to measure directly, but many authors assume that it is positively related to uncertainty about the value of the stock. (As Beatty and Ritter (1986) discuss, information asymmetry and uncertainty are not

[8] Prabhala and Puri (1999) suggest an alternative measure of price support, namely an indicator variable that is one if the IPO closes at the offer price (stabilized) and zero if it closes below the offer (not stabilized). This measure assumes that stocks trading below the offer price are not stabilized, which is inconsistent with the evidence in Section 4. Also, the measure could bias the relation between price support and stock characteristics towards finding more price support for less volatile stocks, i.e., stabilized stocks that remain longer at the offer price. For these reasons, I use the inventory-accumulation and bid-stickiness measures.

equivalent.) If this assumption is correct, we might observe a positive association between price support and IPO risk.

However, there are also reasons to expect the opposite relation. If investors view price support as an option to sell IPO shares at or close to the offer price, the option is more valuable (and more costly to the underwriter) for riskier stocks. Thus, less stabilization and lower underpricing might be needed to encourage investors to participate in the distribution.[9] Similarly, if stabilization requires underwriters to hold large inventories in the IPO stock, they might be less willing to support riskier, more volatile stocks. It is difficult to know how important these risk considerations are in practice because underwriters can implicitly hedge inventory risk. Aggarwal (2000) shows that underwriters almost always oversell the issue and start the first trading day with a short position. They have an option to cover this short position in the aftermarket or to purchase up to 15% of shares offered from the issuer. Aggarwal reports that the average short position in her sample is 17.01% of shares offered. I do not have data on short positions, but in my sample inventory accumulation (by day 20) exceeds 17% for 79 out of 280 cold IPOs. It is possible that the inventory build up rarely exceeds the short position.

In Section 5.2, I argue that underwriter reputation plays a key role in the stabilization decision. First, incidents of overpricing hurt underwriter reputation with investors, and price support can be viewed as an ex-post action to repair the damage. Second, price support is a discretionary rather than legally binding commitment, and reputation makes it possible that this commitment is honored. These arguments suggest that price support and underwriter reputation should be related. An obvious hypothesis is that larger and more reputable underwriters are more concerned with loosing reputation and, consequently, are more likely to engage in price support. Consistent with this argument, Dunbar (2000) finds evidence that larger underwriters loose significantly more market share as a consequence of inaccurately priced IPOs.[10]

To further explore the reputation hypothesis, I test whether underwriters are more likely to engage in price support when their reputation seems more threatened by the appearance of mispricing. Suppose that a low first-day IPO return coincides with a negative market return, caused,

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[9] Moreover, Prabhala and Puri (1999) argue that stabilization encourages underwriters to produce more information at the pre-offering stage. This is another reason to expect a negative relation between the amount of price support and the observed riskiness of the IPO.

[10] Alternatively, one could argue that larger underwriters are able to better diversify inventory risks and absorb the potential losses from price support. Thus, the risk story implies a positive relation between underwriter size and price support. However, the evidence in Aggarwal, and Ellis et al. suggest that underwriters are able to hedge stabilization risks, so that risk considerations may not be of the first-order importance.

for example, by unfavorable macroeconomic or industry-related news. If the underwriter is not expected to predict such market-wide events accurately, his reputation may be less severely affected. Alternatively, if the negative initial return appears unrelated to the overall market movements, it may be more likely interpreted as an avoidable valuation mistake. Following this idea, I test whether the amount of price support associated with a given offering is negatively associated with the stock market return on the first trading day.

5.3 Regression results

The price-support regressions are presented in Table 6a. The sample consists of 280 cold IPOs, and the dependent variable is the total marketmakers' inventory accumulation on day one in percent of shares offered. Figure 4 shows the distribution of the dependent variable across IPO deciles formed based on IPO proceeds and underwriter rank. I use three proxies for IPO risk and the degree of information asymmetries: IPO size measured as logarithm of total proceeds, gross spread, and aftermarket volatility. The common assumption is that larger uncertainty and more information asymmetries are associated with smaller offerings, and that underwriters require higher gross spreads for IPOs that are more difficult to price. Aftermarket volatility, computed from daily returns from day 41 through 125 after IPO, can be interpreted as a direct measure of price uncertainty in the aftermarket and as a proxy for ex ante risk.

In unreported univariate regressions, stocks that are larger and have lower gross spreads are more strongly stabilized, but there is no significant relation between volatility and price support. I drop volatility from all reported regressions because its inclusion has no impact on results but it reduces the sample size. In a multivariate regression in Table 6a, which controls for several IPO characteristics (VC involvement, internet and high-tech dummies, and year dummies), only IPO size remains statistically significant. The coefficient of 4.12 on IPO size in column 1 of Table 6a suggests that an increase in size by one standard deviation at the mean is associated with an increase in the first-day inventory accumulation by 4.07% of shares offered.

I use underwriter's market share as a proxy for his size and reputation (similar as in Megginson and Weiss (1991)). The market share is computed based on aggregate proceeds of all IPOs taken public in 1990s. Controlling for IPO risk, there is a strong positive association between price support and underwriter size. The coefficient on this measure is positive with t-statistic of 4.61. It implies that a one standard deviation increase in underwriter's market share increases inventory accumulation by 2.67% of shares offered. Interestingly, when underwriter size is included, the coefficient on IPO size drops by more than half in the full sample, although it remains statistically significant. In addition, to

underwriter's size, I include a measure of syndicate's size to capture the total syndicate's ability to absorb inventory risk. The syndicate's size, measured as the number of syndicate members, is also positively associated with price support, but it is statistically significant in only one of the four specifications.

Consistent with the reputation hypothesis, I find that underwriters are less inclined to support weak IPOs on days when the stock market is doing poorly. The coefficient on Nasdaq return, measured on the first trading day of the IPO, is positive and statistically significant. The coefficient seems economically significant: the regression in the fourth column in Table 6a suggests that an increase in the Nasdaq return by one percentage point increases the inventory accumulation on day one by 0.9% of shares offered. As a robustness test, I replace the Nasdaq return with a dummy variable equal to one when the return is positive or zero (the results are not reported). The coefficient on the dummy variable is statistically significant, and it indicates that underwriters repurchase 1.9% of shares offered less on days when the Nasdaq return is negative. Finally, the regressions in columns 5 and 6 of Table 6a, include the IPO initial return as an additional control variable. The coefficient on the initial return is negative and significant, consistent with the results in Table 3, but its inclusions has no significant impact on the results.

In sum, the basic regressions provide no evidence that stocks with greater information asymmetries are more strongly supported. There is some indication that riskier IPOs are less strongly stabilized, which is consistent with the inventory-costs story. Consistent with the reputation hypothesis, less price support occurs on days when the Nasdaq return are low. Finally, underwriter's size emerges as the strongest determinant of price support. I explore this last result in more detail in the following sections.

5.3.1 Role of the lead underwriter

Larger underwriters may be more willing to support IPOs for reputational reasons or because they can better absorb inventory risks. However, it is also possible that an underwriter's rank proxies for other bank characteristics omitted from the regressions. Before discussing this possibility further, Tables 6a and 6b provide some indication of whether underwriter heterogeneity, beyond size and reputation, can help explain variation in price support. The regressions in columns 3 and 6 of Table 6a include 20 dummy variables for each of the top-20 lead underwriters. (Underwriter rank is left out of the regression because it induces multicollinearity.) The table shows that adjusted R^2 jumps substantially, from 18% to 27%, when underwriter rank is replaced by underwriter dummies. The increase is even higher, from 19% to 32%, for the subs-ample that includes only IPOs underwritten

by the top 20 underwriters (this result is not reported). These findings suggest that size alone does not fully capture the important heterogeneity among investment banks.

A closer look at the lead dummies in Table 6b reveals that the underwriter fixed effects are economically highly significant. For example, controlling for IPO characteristics, the average inventory accumulation for stocks underwritten by "Bank 3" is 14.4% of shares offered higher than for smaller (i.e., not top-20) investment banks. For comparison, this estimate is –5.9% for "bank 19". (The banks are numbered based the coefficients on dummy variables.) It seems that the strong differences in price support across banks are to large extent independent of underwriter's size and reputation: all top-20 investment banks enjoy substantial fractions of the IPO market, have long traditions as lead underwriters, and seem similarly able to absorb losses from price support. Thus, the interesting question is what common characteristics of these banks are responsible for the differences in their stabilization decisions.

5.4 A closer look at the lead underwriter

Besides size and reputation, several characteristics might explain differences in price support across underwriters. Aggarwal (2003) shows that investment banks with retail brokerage operations distribute larger fractions of IPOs to retail investors.[11] (I find supporting evidence by comparing the average trade size in the aftermarket for retail and institutional banks.[12]) Investor mix could be important for price support. First, BBW and CN suggest that price support is designed to benefit a specific type of investors. For example, if price support is targeted at institutional investors (as in BBW), one might expect that "institutional banks," i.e., those with a higher fraction of institutional customers, will stabilize more. Second, Hanley et al. (1993) suggest that stabilization is used to conceal overpricing. This strategy should be more successful with unsophisticated investors, so price support could be more valuable to "retail" banks. Finally, one could make the case that unsophisticated investors rely more heavily on underwriter reputation when making their decision to participate in an IPO. (I discuss this possibility further in Section 5.4.2.) Thus, reputation concerns could also induce more price support for retail banks.

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[11] Underwriters might favor their own customers in IPO distributions for several reasons. First, it might simply be cost efficient for an underwriter to approach existing customers. Second, anecdotal accounts in financial press suggest that underwriters allocate IPOs to their own customers in exchange for brokerage commissions and other services. See, for example, Wall Street Journal articles by Smith and McGee (2000), Pulliam, Smith, and Gasparino (2000), and Gasparino, Craig, and Smith (2002).

[12] In particular, I find that the average size of an investor's sale on the first trading day after the IPO is significantly lower for retail banks than for other top-20 investment banks, and the difference is significant at a 1% level.

Recent accounts in the financial press suggest that underwriters use IPO allocations to compensate favored clients for high brokerage commissions and other services. These anecdotes suggest that complementarities (or conflicts of interest) among various business segments of an investment bank could affect its IPO-related decisions, including price support. For example, the value of IPO shares as a mean to reward brokerage customers is probably small for banks with no significant brokerage operations. Alternatively, banks with smaller brokerage divisions may use price support more extensively if they try to attract additional customers. Although the sign of these relations is difficult to predict a priori, I use several proxies for investment bank's "type" as control variables. I measure the relative importance the bank's business segments by the segment's contribution to the total revenues.

5.4.1 Sample and descriptive statistics

The analysis focuses on IPOs underwritten by top-20 investment banks. The banks are publicly traded, so their financial statements are available during my sample period. (In some regressions, I drop three banks because the financial data is incomplete.[13]) Tables 1 and 2 compare IPOs underwritten by the top investment banks to other IPOs. The top banks account for 52% of all IPOs in the sample and 74% of aggregate sample proceeds. Consistent with previous literature (e.g., Megginson and Weiss (1991)), the 20 largest banks underwrite larger IPOs, raise higher proceeds, and charge lower gross spreads than their competitors. Also, IPOs from top underwriters are more likely to have venture capital backing and to come from a high-tech or internet sector. Finally, Table 1 shows that the cold IPOs taken public by large underwriters experience substantially higher first-day inventory accumulation than the cold IPOs in the total sample (12.35% and 7.73% of shares offered, respectively).

5.4.2 Regression results

Table 7 shows the first-day inventory accumulation regressed on various characteristics of the lead underwriter and a set of control variables. As discussed earlier, the fraction of retail vs. institutional customers of the investment bank could influence the bank's commitment to price support. To capture this bank characteristic, I create a dummy variable that identifies investment

[13] I could not find consistent data on total assets under management for Lehman Brothers, Montgomery Securities, and Robertson Stephens & Co.

banks with retail brokerage operations.[14] In addition, I search the investment bank's annual reports and 10-K filings for information about the composition of the bank's assets under management. Although some banks disclose what fraction of the total assets is managed for institutional and retail customers (or at least what fraction is managed in separate customer accounts vs. mutual funds), many financial statements contain no details about asset composition. Consequently, I combine financial statement data on the total assets under management with information on aggregate net asset value of all mutual funds managed by the investment bank that can be found in the CRSP Mutual Funds Database.[15] I assume that the ratio of mutual funds to total assets under management proxies for the relative importance of retail vs. institutional customers of the bank's asset management division. Alternatively, the relative importance of the bank's retail operations is measured by the bank's mutual funds assets scaled by the aggregate IPO proceeds underwritten by the bank in the 1990s. Finally, to capture the relative importance of the bank's various business segments, I collect information on the bank's revenues sources from the annual 10-K filings and annual reports.

Table 7 suggests that underwriter type is an important determinant of price support, beyond the effects of size and reputation. Controlling for rank and IPO characteristics, all variables that measure the importance of retail customers have positive coefficients, and two out of three are statistically significant. When all retail proxies are included, only the retail dummy remains significant (the t-statistic in column 8 is 3.02). The coefficient in the multivariate regression in column 8 implies that, when an IPO performs poorly on the first trading day, retail banks repurchase 10.6% of shares offered more on day one than other top investment banks.

Interestingly, the variables describing investment bank's revenue composition add substantial explanatory power in the price-support regressions after controlling for the retail proxies: the R squared in a regression with underwriter rank, retail dummy and other IPO characteristics is 36% (for the unreported regression for 100 IPOs with available revenue proxies), compared to 42% when the revenue measures are included. Banks with higher fraction of asset management fees and brokerage commissions to total revenues appear to repurchase a smaller fraction of shares offered for cold

[14] More precisely, the dummy variable is equal to one if I find a reference to retail brokerage in the bank's annual report or 10-K filing for the fiscal year 1999. If a bank was acquired during the sample period, I take the last financial statement that exists for the bank before the acquisition.

[15] Total net assets of a mutual fund is the market value of all securities owned by the mutual funds, plus all assets minus all liabilities. The net asset value is measured at the end of year 1999 or the last year in which the bank appears in the sample. A mutual fund is considered as "managed" by an investment bank if the investment bank is responsible for electing the fund manager.

IPOs. Finally, to be consistent with the full-sample regressions, I include the first-day Nasdaq return and the initial return in the regression in column 8 of Table 7 (to save space, this regression is not reported). The coefficients on these variables are similar to those reported for the full sample, but the coefficient on the Nasdaq return is no longer significant (the t-statistic is 1.5).[16]

5.4.3 Why do retail banks stabilize more?

One of the most striking results in Table 7 is that retail banks repurchase larger fractions of cold IPOs' shares than other investment banks. Below, I suggest three potential explanations for this finding.

Are retail banks more concerned about their reputation with investors? I have argued that price support can be viewed as an ex-post action by the underwriter to protect his reputation with investors. An underwriter who sees the IPO's price decline in the aftermarket, can choose to reduce the losses to initial investors through price support, and thereby mitigate the negative reputation effect associated with negative initial returns. Taking this perspective, one could argue that some banks (e.g., retail banks) are more negatively affected by the ex-post overpricing, which gives them stronger incentives to stabilize.

Suppose that institutional investors know more about the IPO value at the time of the offering than retail investors. Consequently, they are also better equipped to evaluate underwriter's performance in pricing the IPO. In particular, they can better assess whether the aftermarket price decline is a consequence of underwriter's deliberate overpricing, his insufficient due diligence in the pre-offering stage, or simply bad luck. In contrast, the less informed investors must rely more strongly on the observed history of initial returns to infer underwriter's true ability and effort in pricing the IPO. If this reasoning is correct, underwriters that market IPOs more extensively to retail investors may be more concerned with the effects of overpricing on investors' perception and on the demand for future IPOs. Such underwriters may be more inclined to intervene in the aftermarket to prevent price declines. This story seems consistent with the finding in this paper that retail banks engage more heavily in price support.

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[16] The results in Table 7 are similar when bid rigidity (i.e., the ratio of inventory accumulation on day one to the number of bid adjustments on day one plus one) is used as a measure of price support. This measure is positively and significantly associated with underwriter rank and the retail dummy. However, the regressions have lower adjusted R squares (ranging from 9% to 15%), and the variables measuring the composition of revenues are not significant determinants of price support. The results for the full sample regressions in Table 6a are also consistent across the two measures.

Do retail banks manipulate prices to deceive small investors? Hanley et al. (1993) suggest that investment banks use price support to conceal the true market price from investors. They argue that price support temporarily inflates the stock price. By delaying a price decline for several days after the IPO, the underwriter makes it more difficult for naïve investors to identify overpriced stocks. Similar as the reputation story, Hanley et al. argument suggests that price support could be more important for retail banks, assuming retail customers are less sophisticated investors. The evidence here is inconsistent with this view. First, I find no evidence that prices decline once stabilization is withdrawn, so banks do not seem to pursue the naïve camouflage strategy. Second, I test whether retail investors are more confused about the price effects of price support than institutional investors. In particular, I test whether more extensive retail net buying on day one relative to the institutional net buying predicts more negative future returns for cold IPOs. I find only weak support for this hypothesis.[17]

A related idea is that retail banks try to prevent positive-feedback trading. Anecdotal accounts suggest that unsophisticated investors behave like momentum traders: they tend to buy IPOs after stock price increases. Such momentum trading could give raise to price stabilization if underwriters try to prevent selling pressure by concealing the weakest IPOs. Again, however, this theory is inconsistent with the data: I find no evidence of retail selling pressure, even for the weakest IPOs.[18] Also, anecdotal evidence suggests that investment banks can prevent investors from flipping cold IPOs by threatening exclusion from future offerings. If investment banks can control flipping directly, they may not need to use price support for the same purpose. In short, there is little evidence that retail banks stabilize more to disguise market prices from retail investors.

Do retail banks use price support to discriminate among investors? Retail banks generally provide brokerage and other services to retail *and* institutions customers, whereas institutional banks tend to focus on the latter group.[19] Customer heterogeneity might be reflected in the investor mix that

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[17] For each stock, I measure the average size of an investor buy to the average size of an investor sell on the first trading day. High ratios suggest higher institutional net buying volume relative to the retail net buying volume. In unreported tests, I find weak evidence that higher ratios predict more positive cumulative returns during 20 days after IPO. Specifically, I find that an above-median ratio predicts significantly positive cumulative returns for four out of 20 days after the IPO. This result holds only in a sub-sample of cold IPOs with above-median marketmakers' inventory accumulation on day one. There is no predictability in the sub-sample of cold IPOs with below-median accumulation.

[18] I assume that an average trade by retail investors is smaller than an average trade by an institution. Thus, as a proxy for retail trading, I examine separately trades above and below 1,000 shares. I find that net selling volume for cold IPOs is caused entirely by large and medium trades. In fact, small trades induce a net *buying* volume for IPOs that open below the offer price.

[19] The composition of assets under management provides an indication of customer heterogeneity. For example, J.P. Morgan reports in 2000 that it manages $270 billion assets for institutions and $79 billion assets for high-net-

receives IPO allocations. If retail banks distribute IPOs to a more heterogeneous investors group, it might be more important for these banks to discriminate among investors by offering some investors more favorable terms than others. Price support is one way to achieve such discrimination: a promise to repurchase IPO shares in the aftermarket can be offered selectively to a specific investor group. The literature suggests two reasons why discrimination could be important. (1) CN argue that price support is a put option given *specifically* to uninformed investors to compensate them for the winner's curse. (2) BBW suggest that price support is offered selectively to institutional investors in exchange for information in the pre-offering period.

The evidence in this paper, combined with the direct evidence on flipping in Aggarwal (2003), is consistent with both types of discrimination. Aggarwal documents that institutions flip larger fractions of their IPO allocations than retail investors, as predicted by the BBW hypothesis. However, two pieces of evidence point towards the alternative view. (1) Retail investors receive relatively high allocations of overpriced IPOs, consistent with the winner's curse. (2) In Section 4.4, I find only weak evidence that the withdrawal of price support causes significant price declines. Thus, it is possible that price support benefits *all* initial investors, including retail investors who do not immediately flip their shares. In short, both theory and empirical evidence suggests that price support allows underwriter to discriminate among different investors' groups. This could explain why retail banks, who face more heterogeneous investors' mix, use price support more extensively.

6 Conclusions

Researchers have proposed a wide range of explanations for price support, but there have been relatively few empirical studies, in part because of the limited availability of precise measures of stabilization. This paper provides the first comprehensive study of price support for a large sample of IPOs. It explores both the variation of price support across stocks and the effects of price support on prices and trading volume in the aftermarket.

BBW and CN argue that price support, similar to underpricing, helps to reduce adverse-selection problems in the IPO market. A natural implication is that, other things equal, stocks with more severe information asymmetries should exhibit more underpricing or stronger price support. I find no support for this conjecture. Instead, stabilization appears to be stronger for larger stocks and for IPOs underwritten by more reputable underwriters. CN argue that price support is costly to the underwriter

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worth individuals. There is no mention of retail customers. In contrast, Prudential Financial report in 2001 that it manages $96.5 billion assets for retail customers and $89.1 billion assets for institutions. According to the annual statement, retail accounts include individual mutual funds, variable annuities, and variable life insurance.

because it requires holding inventories of the IPO stock. This could explain why larger underwriters who can probably better deal with inventory risk are more willing to stabilize IPOs. Alternatively, it is possible that larger underwriters stabilize more to protect their reputation with potential investors. Reputational reasons for price support received little attention in the theoretical literature and it may be interesting to explore this motive in future research.

Prior studies argue that price support benefits mainly institutional investors, consistent with the BBW story. For example, Aggarwal (2003) shows that institutions flip larger fractions of their IPO allocations within the first few days of trading than retail investors. However, I find no evidence that IPO prices decline significantly after stabilization is withdrawn. Thus, it is possible that all initial investors benefit from price support, including retail investors who do not immediately flip their shares. Moreover, I find strong evidence that retail banks, i.e., those with larger retail brokerage operations, are more committed to price support. On average, these banks repurchase 10.6% of shares offered more on day one (for cold IPOs) than other top-20 investment banks. These findings seem inconsistent with price support being targeted primarily at institutional investors.

Again, reputational concerns could potentially explain these findings. Suppose that unsophisticated investors rely more strongly on underwriter reputation than the better informed institutional investors. In this case, retail banks could be more concerned with reputation losses caused by negative initial returns, and, consequently, could be more inclined to engage in price support to protect their reputations. Alternatively, if retail banks face more heterogeneous investors' group than institutional banks, they may use price support more extensively to discriminate among the different investors' types. This latter hypothesis is consistent with the models of price support by BBW and CN.

Generally, there is little evidence in favor of Hanley et al. (1993) "camouflage" hypothesis. First, price support appears to have a long-lasting rather than a temporary effect on prices. Second, there is no evidence that unsophisticated investors are deceived by price support and end-up buying cold IPOs at temporarily inflated prices. The finding that price support has a permanent effect on prices is consistent with Schultz and Zaman (1993). However, their theory alone does not explain any of the cross-sectional regularities in the data.

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Figure 1
Frequency of trading at various bid levels relative to the offer price for 1,422 Nasdaq IPOs from January 1996 through December 1999

The figure shows the average percentage fraction of trades on the first trading day occurring at each bid level. The bid level is expressed in the number of ticks ($0.125) above the offer price. First, I compute for each stock the fraction of trades occurring at each bid level. Then the fractions are averaged across stocks for each bid level.

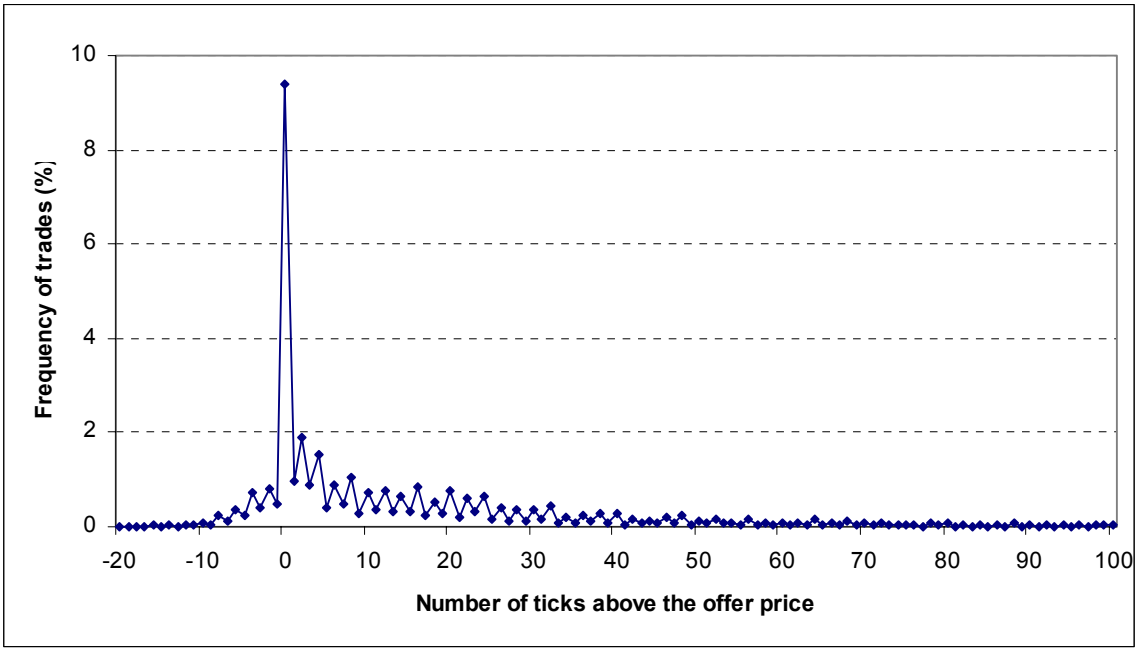

Figure 2
Marketmakers' inventories on the first trading day after IPO for 1,422 Nasdaq IPOs from January 1996 through December 1999

MM inventory is the marketmakers' inventory accumulation on the first day after the IPO in percent of shares offered. Fig. 2a shows average total MM inventory accumulation on day one. Stocks are assigned to one of the five groups if at least 70% of trades on day one occur within a given price range (bright bars), or if the opening return is in a given price range (dark bars). The opening return is measured from the offer price to the first quoted bid. Fig. 2b shows the average inventory accumulation preceding a bid decrease (increase) on day one. For example, the middle bright bar shows that when a bid is at the offer price on day one, marketmakers accumulate, on average, 3.31% of shares offered before they revise the bid downwards.

Fig. 2a

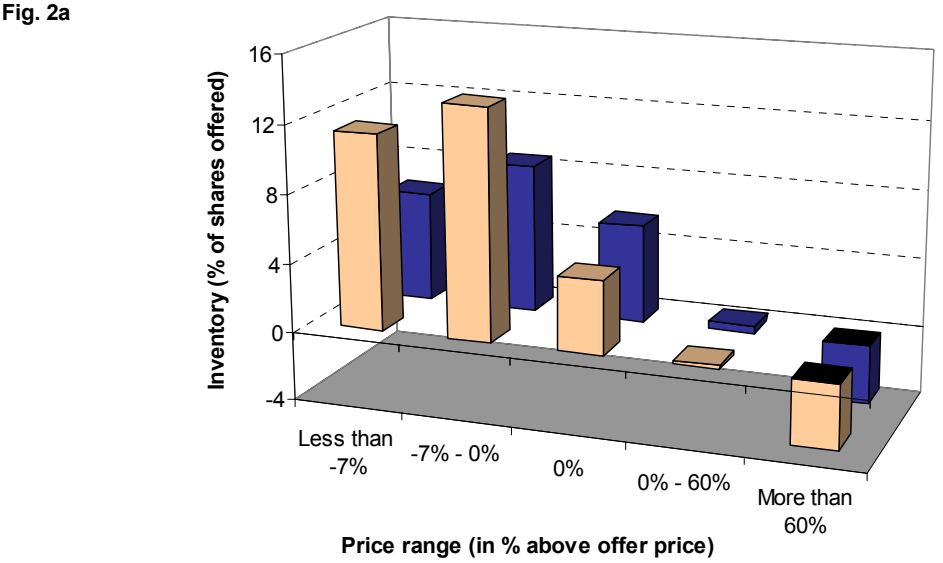

Fig. 2b

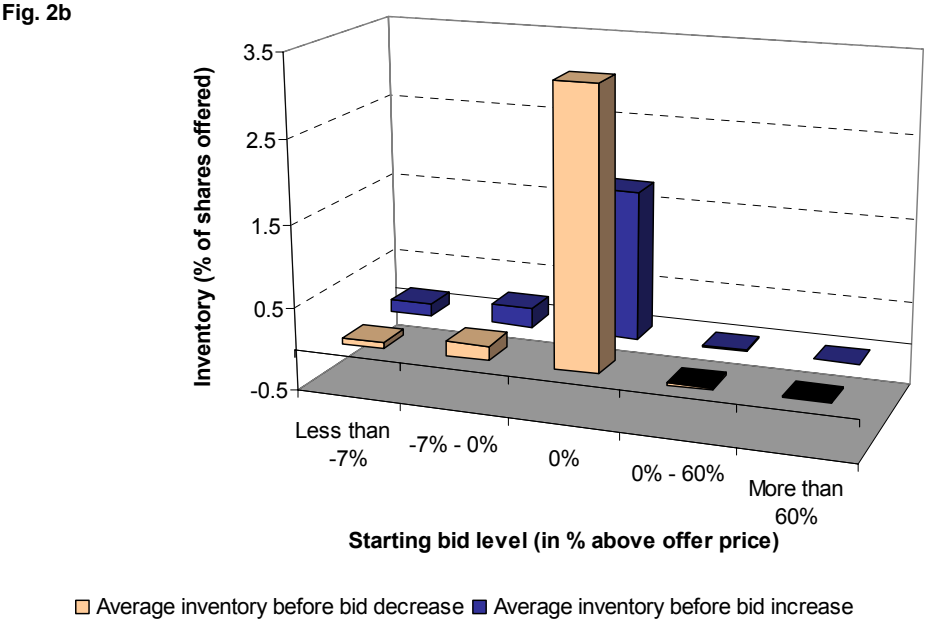

Figure 3
Aggregate marketmakers' inventory accumulation during the first 20 trading days after IPO for 1,422 Nasdaq IPOs from January 1996 through December 1999

Fig. 3a depicts the average marketmakers' inventory accumulation during the first 20 trading days after IPO. Fig. 3b shows the average accumulation during day one split into 84 five-minutes intervals. The averages are computed for four groups of stocks classified based on the level of the opening and closing bid on day one relative to the offer price.

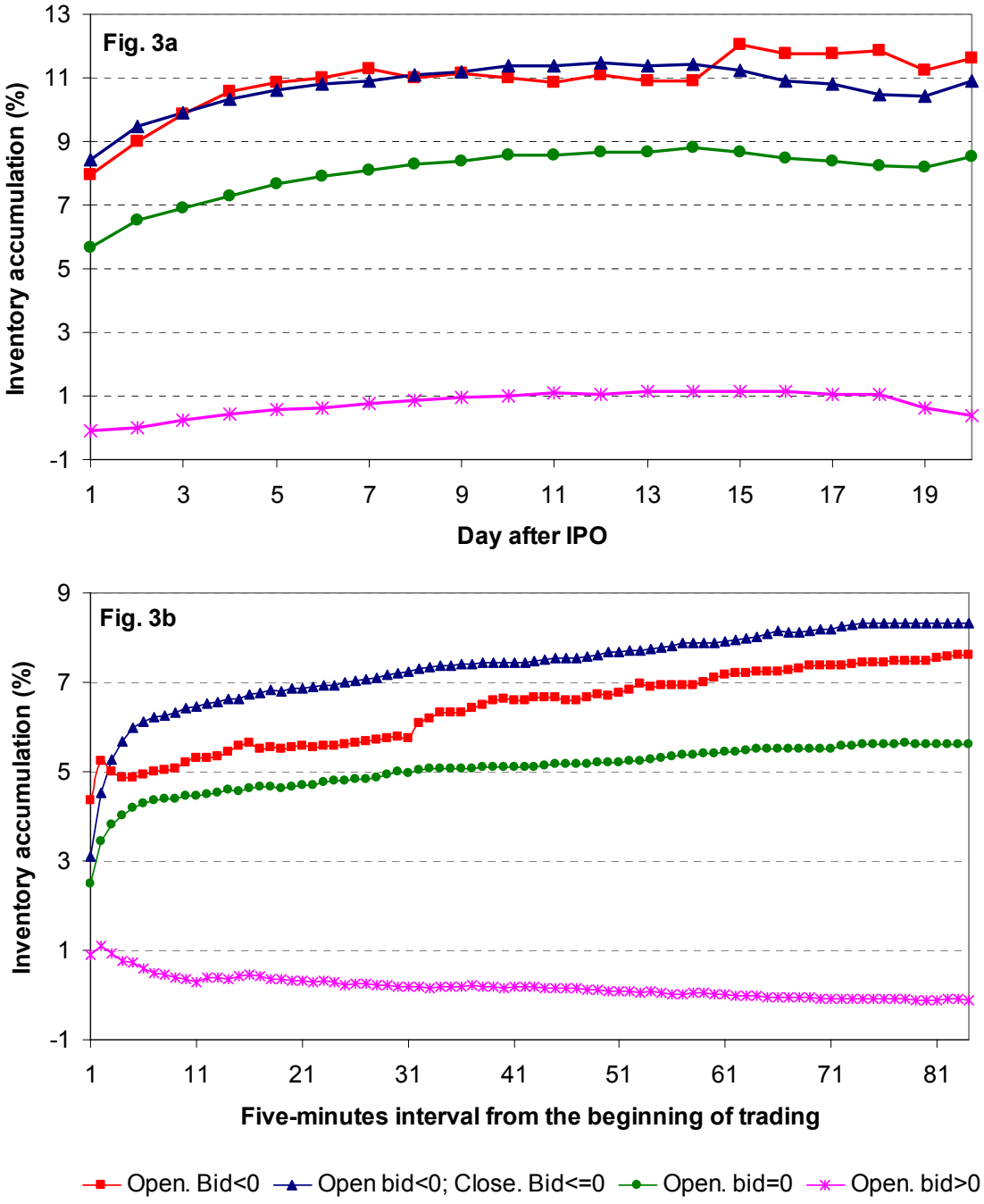

Figure 4
Aggregate marketmakers' inventory accumulation on day one for IPO deciles formed based on total proceeds or underwriter size for 280 cold IPOs from January 1996 through December 1999

An IPO is classified as cold if its initial return is equal to or less than zero. The cold IPOs are grouped into deciles based on total proceeds or underwriter size. Underwriter size is measured as total proceeds of IPOs underwritten by the underwriter during the 1990s in percent of total proceeds of all IPOs in the 1990s.

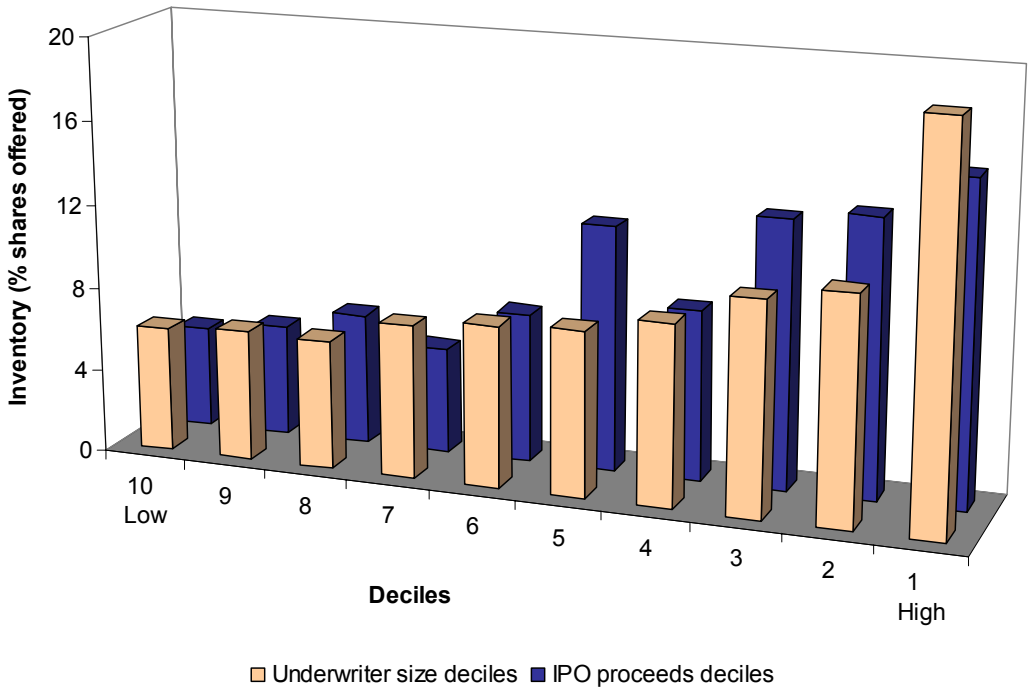

Table 1
Descriptive statistics for 1,422 Nasdaq IPOs from 1996 to 1999

An IPO is classified as cold if its initial return is equal to or less than zero. Top 20 underwriters are selected based on the variable URANK which equals total proceeds of IPOs underwritten by the underwriter during the 1990s in percent of total proceeds of all IPOs in 1990s. PROC ($ mil.) are the IPO proceeds. VC is a dummy variable equal to one if the IPO is backed by venture capital. HT is the SDC dummy variable for high-tech IPOs. INTERNET is a dummy variable for internet IPOs. SYND is the number of banks in the underwriting syndicate. INV is the marketmakers' accumulation of the IPO shares on the first day after IPO in percent of shares offered. IRET is the initial return = (closing price on day one – offer price)/offer price. RETAIL is equal to one if the underwriter has major retail brokerage operations. MF/ASS is the ratio of mutual-funds assets to total assets under management for the lead underwriter. MF/IPO is the ratio of mutual funds assets managed by the underwriter to the volume of IPOs taken public by the underwriter in the 1990s. ASMAN, COMMIS, INVBANK, PRINC are the fractions of underwriter's revenues derived from asset management fees, commissions, investment banking, and principal transactions, respectively. The last six rows of the table show descriptive statistics for the underwriters rather than the IPOs; the retail dummy and the mutual-fund ratios are computed based on data from the last year in which the bank appears in the sample; the revenue variables are first averaged for each bank across years and then across investment banks.

	All underwriters						Top 20 underwriters					
	Cold IPOs (280)			All IPOs (1,422)			Cold IPOs (122)			All IPOs (738)		
	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
PROC	35.44	24.90	32.54	49.36	35.00	97.91	52.34	38.15	39.12	70.66	48.40	130.76
GRSP	7.29	7.00	0.93	7.25	7.00	0.88	6.93	7.00	0.39	6.94	7.00	0.28
VC	0.45	0.00	0.50	0.46	0.00	0.50	0.56	1.00	0.50	0.61	1.00	0.49
HT	0.54	1.00	0.50	0.58	1.00	0.49	0.63	1.00	0.48	0.68	1.00	0.47
INTERNET	0.16	0.00	0.37	0.20	0.00	0.40	0.19	0.00	0.39	0.29	0.00	0.45
SYND	2.40	2.00	1.13	2.54	2.00	1.18	2.81	3.00	0.96	2.96	3.00	0.90
URANK	1.61	0.32	3.56	3.16	0.72	6.34	3.54	1.42	4.75	5.97	2.46	7.82
INV	9.03	6.90	9.46	1.64	0.23	8.91	11.82	10.09	10.50	1.73	0.00	8.68
IRET	-0.03	0.00	0.06	0.31	0.13	0.58	-0.04	-0.01	0.07	0.45	0.20	0.71
RETAIL										0.55	1.00	0.51
MF/ASS										0.31	0.29	0.25
MF/IPO										14.98	5.89	19.07
ASSMAN										0.07	0.07	0.05
COMMIS										0.11	0.08	0.08
INVBANK										0.17	0.10	0.16
PRINC										0.17	0.17	0.06

Table 2
Descriptive statistics by year for 1,422 Nasdaq IPOs from 1996 to 1999

Top 20 underwriters are selected based on the variable URANK which equals total proceeds of IPOs underwritten by the underwriter during the 1990s in percent of total proceeds all IPOs in 1990s. PROC ($ mil.) are the IPO proceeds. VC is a dummy variable equal to one if the IPO is backed by venture capital. HT is the SDC dummy variable for high-tech IPOs. INTERNET is a dummy variable for internet IPOs. SYND is the number of banks in the underwriting syndicate. INV is the marketmakers' accumulation of the IPO shares on the first day after IPO in percent of shares offered. IRET is the initial return = (closing price on day one – offer price)/offer price.

	All underwriters (1,422 IPOs)				Top 20 underwriters (738 IPOs)			
Year	1996	1997	1998	1999	1996	1997	1998	1999
PROC	36.51	39.13	46.68	80.53	52.51	58.44	71.27	93.79
GRSP	7.35	7.34	7.24	7.02	6.93	6.96	6.93	6.95
VC	0.45	0.36	0.33	0.67	0.56	0.49	0.47	0.78
HT	0.52	0.49	0.46	0.84	0.58	0.51	0.58	0.88
INTERNET	0.05	0.06	0.14	0.61	0.07	0.06	0.24	0.63
SYND	2.20	2.25	2.42	3.40	2.56	2.59	2.99	3.51
URANK	2.15	2.17	3.40	5.54	4.50	5.06	7.57	7.27
INV	1.53	2.54	3.07	0.09	2.45	3.30	4.77	-0.81
IRET	0.18	0.15	0.24	0.73	0.19	0.18	0.37	0.86
RET 5	0.00	0.00	-0.01	0.01	0.00	0.00	-0.02	0.02
RET 10	0.00	-0.01	-0.02	0.02	0.01	0.01	-0.03	0.04
RET 20	0.02	0.00	0.00	0.16	0.04	0.01	0.01	0.19

Table 3
Marketmakers' inventories and trading imbalance on the first trading day after IPO for 1,422 Nasdaq IPOs from January 1996 through December 1999

MM inventory is the marketmakers' inventory accumulation on the first day after the IPO in percent of shares offered. Trading imbalance is computed based on the Lee and Ready (1991) algorithm as the seller-initiated transaction volume minus the buyer-initiated transaction volume on day one in percent of shares offered. In Panel A, stocks are assigned to one of the five sub-samples if at least 70% of trades on day one occur within a given price range. In Panel B, stocks are classified based on the opening return, i.e., the return from the offer price to the first quoted bid. Panels A and B describe the total MM inventory accumulation and trading imbalance on day one. Panel C (D) shows the average inventory accumulation and trading imbalance preceding a bid decrease (increase) on day one. For example, Panel C shows that when a bid is at the offer price on day one, marketmakers accumulate, on average, 3.31% of shares offered before they revise the bid downwards.

	MM Inventory			Trading Imbalance			
Price range	Mean	Median	Std	Mean	Median	Std	N
Panel A: Total inventories (trading imbalance): stocks trading 70% of times in a given range							
Less than -7%	11.43	8.66	11.53	12.06	10.17	15.43	16
7% - 0%	13.43	12.45	8.62	20.36	17.15	17.76	38
0%	4.33	0.80	6.99	32.40	30.36	18.89	54
0% - 60%	0.23	0.07	5.84	11.17	7.96	18.07	878
More than 60%	-3.76	-3.08	10.98	0.11	1.95	25.15	180
Panel B: Total inventories (trading imbalance): stocks with the opening return in a given range							
Less than -7%	6.42	5.42	6.51	8.58	4.49	11.98	13
7% - 0%	8.64	8.18	9.62	16.19	15.19	16.65	30
0%	5.68	1.56	9.26	18.34	14.91	18.19	392
0%[a]	8.42	4.69	9.96	25.16	21.82	18.70	228
0% - 60%	0.45	0.04	7.50	12.46	8.65	20.10	809
More than 60%	-3.39	-3.31	9.79	1.14	1.95	25.08	178
Panel C: Inventories (trading imbalance) before a bid decrease by the level of the current bid							
Less than -7%	0.06	0.00	0.77	0.19	0.02	1.55	1,346
7% - 0%	0.18	0.01	1.04	0.38	0.03	1.79	1,875
0%	3.31	0.77	5.56	10.35	3.15	14.97	288
0% - 60%	-0.03	0.00	0.89	0.18	0.01	1.44	33,169
More than 60%	-0.01	0.00	0.37	0.00	0.00	0.55	64,563
Panel D: Inventories (trading imbalance) before a bid increase by the level of the current bid							
Less than -7%	0.15	0.00	0.92	0.19	0.00	1.42	1,537
7% - 0%	0.24	0.00	1.51	0.41	0.00	2.34	1,769
0%	1.78	0.20	4.49	4.75	0.58	10.87	785
0% - 60%	0.01	0.00	1.17	0.08	-0.01	1.60	39,384
More than 60%	0.00	0.00	0.58	0.00	-0.01	0.68	81,864

[a] Stocks with opening bid at the offer price and closing bid at or below the offer price.

Table 4
Timing of and selling pressure preceding the first five bid revisions after IPO for 1,422 Nasdaq IPOs from 1996 to 1997

The table shows the average marketmakers' inventory accumulation in percent of shares offered (INV) preceding each subsequent bid decrease (Panel A) and increase (Panel B) starting at the beginning of trading on day one. Stocks are classified based on the opening return, i.e., the return from the offer price to the first quoted bid. For example, the first row in Panel A shows 26 stocks that open below the offer price and for which the first bid revision is a decline. The second row shows 19 stocks that open below the offer price and the first two bid revisions are declines, etc. DAY is the average day after IPO when the bid revision occurs. N is the number of stocks.

Opening Ret.	Less than 0%			0%			More than 0%		
Bid Change	INV	DAY	N	INV	DAY	N	INV	DAY	N
Panel A: Bid decreases									
1	2.13	1.31	26	6.03	3.07	134	0.41	1.06	430
2	1.28	1.00	19	0.90	2.88	112	0.47	1.16	317
3	0.37	1.00	14	0.87	3.38	85	0.40	1.27	234
4	0.57	1.00	8	0.73	3.48	64	-0.03	1.46	166
5	1.58	1.00	5	0.56	3.87	46	-0.02	1.59	129
Panel B: Bid increases									
1	2.68	1.94	17	2.88	2.01	258	0.91	1.08	557
2	-0.25	2.90	10	-0.13	1.63	163	0.28	1.03	413
3	-0.01	1.17	6	-0.02	1.92	117	0.04	1.09	329
4	0.94	1.00	5	0.04	2.19	72	-0.44	1.12	242
5	-0.35	1.00	3	0.10	2.80	49	0.10	1.23	189

Table 5
Cumulative Nasdaq-adjusted returns for 20 days after IPO for 1,422 Nasdaq IPOs from 1996 to 1999

The cumulative bid returns are computed starting from the closing bid on the first trading day. The daily raw returns are adjusted by subtracting the contemporaneous return on the Nasdaq Composite Index. IPOs are grouped based on the level of the closing bid on day one relative to the offer price. Each sub-sample is then divided into two groups with the first-day marketmakers' inventory accumulation below and above the sub-sample median. The t-statistics are for the difference in the mean cumulative return for stocks with below-median inventories and stocks with above-median inventories.

Closing Bid	Below offer price (152 IPOs)				At offer price (194 IPOs)				Above offer price (1,064 IPOs)			
Inventory	All IPOs	Below Median	Above Median	T for Differ.	All IPOs	Below Median	Above Median	T for Differ.	All IPOs	Below Median	Above Median	T for Differ.
2	-0.68	-0.78	-0.59	0.22	-0.98	-0.23	-1.74	-3.12	0.22	0.80	-0.36	-2.24
3	-1.04	-0.94	-1.14	-0.17	-1.07	-0.10	-2.05	-2.28	0.20	0.55	-0.16	-0.98
4	-1.04	-0.70	-1.38	-0.50	-1.55	-0.25	-2.86	-2.37	0.09	0.58	-0.42	-1.23
5	-2.14	-2.02	-2.26	-0.14	-1.58	-0.84	-2.33	-1.27	0.20	0.90	-0.51	-1.53
6	-3.65	-4.14	-3.16	0.58	-1.50	-1.17	-1.84	-0.55	0.17	1.01	-0.70	-1.79
7	-4.28	-5.08	-3.49	0.87	-1.74	-1.27	-2.22	-0.72	0.26	1.11	-0.62	-1.81
8	-4.73	-5.45	-4.01	0.67	-1.92	-0.99	-2.85	-1.25	0.36	1.12	-0.43	-1.62
9	-5.01	-6.43	-3.60	1.03	-2.42	-0.90	-3.95	-1.80	0.72	1.68	-0.27	-1.87
10	-4.83	-6.83	-2.85	1.41	-2.72	-0.79	-4.66	-2.18	1.06	2.20	-0.11	-2.04
11	-4.35	-7.35	-1.38	1.85	-2.85	-0.84	-4.88	-2.13	1.45	3.09	-0.24	-2.71
12	-4.50	-7.18	-1.86	1.71	-2.77	-1.15	-4.42	-1.70	1.95	4.12	-0.28	-3.31
13	-4.99	-7.60	-2.42	1.64	-2.87	-1.34	-4.41	-1.59	2.24	4.40	0.02	-3.26
14	-4.87	-7.12	-2.64	1.35	-3.08	-1.60	-4.58	-1.47	2.76	5.14	0.30	-3.45
15	-4.49	-7.62	-1.35	1.66	-2.85	-2.02	-3.69	-0.79	3.37	6.18	0.47	-3.93
16	-2.92	-6.37	0.45	1.61	-2.56	-2.53	-2.59	-0.03	4.35	7.67	0.93	-4.42
17	-1.73	-6.18	2.54	1.88	-2.85	-2.23	-3.45	-0.55	4.89	8.50	1.17	-4.67
18	-1.13	-6.85	4.37	2.36	-2.15	-1.46	-2.84	-0.58	5.68	9.61	1.61	-4.80
19	-0.68	-6.15	4.64	2.24	-1.56	-0.61	-2.47	-0.73	6.15	9.98	2.15	-4.55
20	-0.04	-6.02	5.04	2.00	-1.17	0.19	-2.42	-0.94	6.37	10.35	2.18	-4.59

Table 6a
Regressions of marketmakers' inventory accumulation on the first day after IPO for 280 cold IPOs from 1996 through 1999

An IPO is classified as cold if its initial return is equal to or less than zero. The dependent variable is the marketmakers' accumulation of the IPO shares on the first day of trading in percent of shares offered. LGPROC is the natural logarithm of the IPO proceeds. GRSP is the gross spread. INTERNET is a dummy variable for internet IPOs. HT is the SDC dummy variable for high-tech IPOs. VC is a dummy variable equal to one if the IPO is backed by venture capital. SYND is the number of banks in the underwriting syndicate. URANK is the underwriter's rank measured as total proceeds of IPOs underwritten by the underwriter during the 1990s in percent of total proceeds of all IPOs in 1990s. NASDAQ is the Nasdaq return on the first day of trading. IRET is the initial return measured from the offer price to the closing price on the first day of trading. Year dummies are included in all regressions. T-statistics are in parentheses. ***, **, * indicate 1%, 5%, 10% significance levels.

Intercept	-7.20	1.34	3.15	0.54	-3.09	-0.68
	(-0.93)	(0.18)	(0.42)	(0.07)	(-0.40)	(-0.09)
LGPROC	4.12***	1.83*	1.88*	1.96**	2.31**	2.35**
	(4.78)	(1.75)	(1.73)	(1.89)	(2.22)	(2.17)
GRSP	0.54	-0.05	-0.10	-0.04	0.16	0.06
	(0.73)	(-0.07)	(-0.15)	(-0.05)	(0.23)	(0.08)
INTERNET	0.15	0.62	0.63	0.90	0.53	0.55
	(0.08)	(0.36)	(0.38)	(0.52)	(0.31)	(0.33)
HT	1.28	1.20	0.72	1.45	1.29	0.72
	(1.02)	(0.99)	(0.60)	(1.20)	(1.07)	(0.61)
VC	-0.75	-1.94	-1.28	-1.98	-1.61	-0.95
	(-0.62)	(-1.57)	(-1.04)	(-1.61)	(-1.32)	(-0.78)
SYND		0.81	0.21	0.83	0.77	0.17
		(1.34)	(0.35)	(1.39)	(1.29)	(0.29)
URANK		0.75***		0.69***	0.65***	
		(4.61)		(4.19)	(4.01)	
NASDAQ				0.94**	0.94**	0.75*
				(2.16)	(2.18)	(1.78)
IRET					-0.23***	-0.23***
					(-2.56)	(-2.54)
Lead dummies[a]	No	No	Yes***	No	No	Yes***
F p-values	--	--	(0.00)	--	--	(0.00)
Adj. R^2	0.12	0.18	0.27	0.19	0.21	0.29

[a] The coefficients on lead dummies are in Table 6b.

Table 6b
Inventory accumulation by lead underwriter for 122 cold IPOs from 1996 through 1999

An IPO is classified as cold if its initial return is equal to or less than zero. The left panel shows coefficients and T-statistics on underwriter dummies in the regression of the marketmakers' first-day inventory accumulation (Table 6a, column 2). The right panel shows the mean and standard deviation of the marketmakers' first-day inventory accumulation for IPOs underwritten by each of the top-20 underwriters. N is the number of IPOs used in the calculation. Underwriters are sorted by the size of the coefficient on the underwriter dummy.

Lead	Table 6a Dummies		Inventory Accumulation		N
	Coefficient	T	Mean	Std	
1	32.52	3.84	43.85		1
2	16.63	2.01	26.01		1
3	14.41	4.55	25.15	9.71	8
4	11.41	1.95	19.91	25.38	2
5	10.65	3.23	20.15	8.46	7
6	9.49	1.89	18.98	5.24	3
7	9.25	2.86	17.59	10.35	7
8	8.54	2.23	18.15	5.44	5
9	5.56	1.32	12.46	8.25	4
10	4.58	1.40	13.97	10.31	7
11	2.17	0.78	10.86	10.29	10
12	1.39	0.57	9.34	8.01	13
13	0.62	0.17	9.61	8.73	6
14	0.03	0.01	7.48	5.39	12
15	-0.25	-0.07	8.41	11.78	5
16	-0.37	-0.10	7.83	9.95	6
17	-1.63	-0.49	6.82	7.49	7
18	-4.27	-1.31	2.58	2.60	7
19	-5.89	-1.93	3.65	4.75	8
20	-6.83	-1.40	3.39	3.57	3

Table 7
Regressions of marketmakers' inventory accumulation on the first day after IPO for 122 cold IPOs underwritten by top-20 underwriters from 1996 through 1999

The dependent variable is the marketmakers' accumulation of the IPO shares on the first day after IPO in percent of shares offered. An IPO is classified as cold if its initial return is equal to or less than zero. LGPROC is the natural logarithm of the IPO proceeds. GRSP is the gross spread. HT is the SDC dummy variable for high-tech IPOs. INTERNET is a dummy variable for internet IPOs. VC is a dummy variable equal to one if the IPO is backed by venture capital. SYND is the number of banks in the underwriting syndicate. URANK is the underwriter's rank measured as total proceeds of IPOs underwritten by the underwriter during the 1990s in percent of total proceeds of all IPOs in 1990s. RETAIL is equal to one if the underwriter has major retail brokerage operations. MF/ASS is the ratio of mutual funds to total assets under management for the lead underwriter. MF/IPO is the ratio of mutual-funds assets managed by the underwriter to the volume of IPOs taken public by the underwriter in the 1990s. ASMAN, COMMIS, PRINC, INVBANK is the fraction of underwriter's revenues derived from asset management, commissions, principal transactions, and investment banking, respectively. All regressions include year dummies. T-statistics are in parentheses. ***, **, * indicate 1%, 5%, 10% significance levels.

LGPROC	-0.28	-0.83	-0.04	0.71	0.85	0.93	0.30	1.25
	(-0.15)	(-0.40)	(-0.02)	(0.38)	(0.44)	(0.48)	(0.15)	(0.65)
GRSP	0.83	1.03	1.20	1.32	0.77	1.03	0.87	2.01
	(0.39)	(0.43)	(0.55)	(0.64)	(0.36)	(0.48)	(0.40)	(0.97)
INTERNET	-3.45	-3.59	-2.83	-6.01**	-6.19**	-6.27**	-5.94**	-6.24**
	(-1.37)	(-1.22)	(-1.07)	(-2.30)	(-2.31)	(-2.31)	(-2.19)	(-2.40)
HT	2.03	2.81	2.43	2.80	3.15	3.12	3.25	3.19
	(1.01)	(1.15)	(1.14)	(1.25)	(1.38)	(1.36)	(1.40)	(1.43)
VC	-1.53	-2.91	-2.21	0.51	0.55	-0.38	-0.37	0.21
	(-0.80)	(-1.32)	(-1.13)	(0.24)	(0.25)	(-0.18)	(-0.17)	(0.10)
SYND	1.73	2.00	1.60	0.61	0.73	1.09	1.46	0.82
	(1.55)	(1.58)	(1.39)	(0.49)	(0.57)	(0.87)	(1.11)	(0.64)
URANK	0.77***	0.77***	0.76***	0.42**	0.55***	0.64***	0.66***	0.41*
	(4.07)	(3.63)	(3.89)	(2.05)	(2.78)	(3.32)	(3.21)	(1.96)
RETAIL	6.10***			11.64***	10.98***	9.01***	8.55***	10.62***
	(3.50)			(4.97)	(4.18)	(4.28)	(3.96)	(3.02)
MF/ASS		5.76						-2.98
		(1.33)						(-0.39)
MF/IPO			0.14***					0.24
			(2.80)					(1.49)
COMMIS				-39.72***				-75.79***
				(-2.62)				(-3.03)
ASSMAN					-32.37			30.74
					(-1.60)			(0.98)
PRINC						13.36		25.51**
						(1.25)		(2.22)
INVBANK							2.01	7.20
							(0.38)	(1.24)
Adj. R^2	0.27	0.20	0.25	0.40	0.37	0.36	0.35	0.42
N	122	107	119	100	100	100	100	100