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An examination of large sell orders in cold IPO aftermarkets ☆

C.N.V. Krishnan[a,*], Ajai K. Singh[a], Allan A. Zebedee[b]

[a] Weatherhead School of Management, Case Western Reserve University, USA

[b] San Diego State University, USA

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Abstract

It is well-known that investment banks routinely take large naked short positions for low demand IPOs, and for such cold IPOs, the immediate sale of initial allocations back to the market accounts for a relatively large proportion of total trading volume. In this paper, we investigate the relationship between investment banks and institutional investors during the stabilization period. Specifically, we hypothesize that lead underwriters cover their short positions through selective share buy-back from institutional investors at the offer price. Using trade data, we examine the trading patterns of large (institutional) and small (retail) trades during the stabilization period. We find that a large proportion of institutional sells take place at the offer price, while a large proportion of retail sells take place below the offer price in a cold IPO stabilization period. We then estimate the information content of all trades to determine whether seller-initiated trades from institutional investors are correctly anticipated by the investment bank in an effort to cover their short position. If they are anticipated, these trades would carry little to no new information. Indeed, we find that the information content of large sell orders in cold IPO aftermarkets is *lower* than the information content of small trades, and is the *least* compared to several control samples. The results are robust and survive controls for external factors such as volume, turnover, and volatility. These results suggest that lead underwriters allow their valuable buy-side clients to sell back cold IPO allocations at the offer price.

JEL classification: G24; G1

Keywords: Initial public offerings; Aftermarket trading; Microstructure

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*Corresponding author. Tel.: 216 368 2116.

E-mail address: cnk2@case.edu (C.N.V. Krishnan).

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0. Introduction

Initial public offerings (IPOs) have evoked considerable scrutiny over the last several years. Specifically, the recent wave of inquiries from the media and regulatory agencies has put practices of lead underwriters of high-demand IPOs under intense scrutiny. These 'hot' IPOs are characterized by severely rationed initial share allocations. There is evidence of 'spinning' or favored allocations of hot IPO shares by investment banking houses to corporate executives in exchange for future business. Investment banks have been charged with imposing unusually high commissions in return for allocations in hot IPOs. Conflict of interest charges have also been filed against financial analysts and the associated investment banking houses for hyping unattractive offers. Prestigious investment banking firms have either already paid fines to settle with regulators or remain under investigation at this time.

In contrast, low-demand ('cold') IPOs have gone relatively unnoticed by the media and regulatory agencies. However, academic studies examining the allocation process and the aftermarket activities for cold IPOs have documented two intriguing empirical regularities. First, the lead underwriter invariably takes a naked short position in cold IPOs, and, second, the immediate sale of IPO allocations back to the market or the underwriting syndicate accounts for a larger proportion of the trading volume in cold IPOs than in hot IPOs. We discuss each of these in turn.

First, Ritter (1998) states that lead underwriters typically pre-sell up to 135% of the number of shares offered in a cold IPO. Given the initial return associated with IPOs, a naked short position would open the investment bank to substantial price risk.[1] However, as Ritter (1998) points out, "the advantage of preselling extra shares is that if many shares are 'flipped,' that is, immediately sold in the aftermarket by investors who had been allocated shares, the investment banker can buy them back and retire the shares, just as if they had never been issued in the first place."

Second, flipping accounts for a significant portion of the volume in the aftermarket and is proportionately larger for cold IPOs than for hot IPOs. Krigman et al. (1999) report that flipping accounts for 45% of first day trading volume in cold IPOs compared to 22% in hot IPOs. Furthermore, institutional trades account for a larger percentage of transactions in cold IPOs than in hot IPOs (16% compared to 8%). The lead underwriter's role as a market maker in the stabilization period provides significant opportunity to the investment bank to repurchase shares to cover its naked short position.[2]

In this paper, we examine the relationship between lead underwriters and institutional investors in the IPO aftermarkets. Specifically, we investigate the possibility that the lead underwriters take the naked short position with an understanding that they can and will cover it by repurchasing shares sold by institutional investors immediately following the

[1]The overallotment option allows the lead underwriter to purchase up to 15% of the shares offered in an IPO at the offer price. Therefore, if the lead underwriter pre-sells up to 135% of the offer, it is covered only up to 115% of the shares offered (the overallotment option covers the additional 15%), leaving the balance as an uncovered 'naked' position. Several studies have examined the extent of lead underwriter short positions, and subsequent price stabilization in cold IPOs (Aggarwal, 2000; Ellis et al., 2000; Fishe, 2002; Schultz and Zaman, 1994.

[2]During the stabilization period the lead underwriter functions as the primary market maker. Several studies, such as Ellis et al. (2000) and Aggarwal et al. (2002), have determined that the stabilization period is complete 20 trading days after the public offering and we, therefore, use the first twenty days of trading as our stabilization period.

offering. In the allocation process, institutional investors tend to subscribe to all IPOs. Despite this uniform participation, they are more likely to immediately sell back their allocation in cold IPOs. The lead underwriter has the incentive to provide such an outlet to institutional investors because the institutional investors are valuable buy-side clients involved in a repeated game. Such an escape mechanism implies that the lead underwriters correctly *anticipate* that some flipped trades will occur. The lead underwriter, thus, first creates a naked short position and then uses the short position to cover the flipped bulk trades in cold IPOs.

To test this hypothesis we examine the information content of trades, which measures the degree to which the market maker or, in this case, the lead underwriter adjusts prices following a trade. If our hypothesis is supported then there would be no information content in flipped bulk trades for the lead underwriter (acting as the market maker) in cold IPO aftermarkets.[3] Empirically, in the absence of our hypothesis, we would expect the information content for large trades in cold IPOs to be relatively large for two reasons. First, Easley et al. (1996) show that the information content of large trades is high when trading volume is low. Krigman et al. (1999) find significantly lower trading volume for cold IPOs than for hot IPOs in the post-IPO aftermarket. Viewed in conjunction these two papers suggest that the information content of large sells must be higher for cold IPOs than for hot IPOs. And, from the market-microstructure literature, the information content of large sells must be higher than the information of small trades. Therefore, finding the information content of large trades in cold IPOs would be construed as support for our hypothesis.

In examining the relationship between the lead underwriter and institutional investors, we first examine the trading patterns during the market stabilization period. Specifically, we document that there is no hard floor at the offer price. We find that a significant share of trades (by both institutional and retail investors) is executed below the stabilization price. On the other hand, the proportion of large sells supported at the offer price is significantly higher than the small sells. For example, the bulk traded shares, as a proportion of the offer size, that are supported at the offer price during the stabilization period is, on average, 16% for cold IPOs. This result is consistent with Aggarwal's (2000) finding that the shares purchased by the lead underwriters in the cold IPO aftermarkets is 16% of the offering size.

We then examine the information content of institutional trades using traditional microstructure measures. We find that the information content of large (institutional) sells during the cold IPO stabilization period is *lower* than the information content of small (retail) trades. We find that the information content of large sells during the cold IPO stabilization period is the *lowest* compared to that of large sells of (a) hot IPOs, (b) medium demand IPOs, (c) IPO firms in the post-IPO period (one year after the offering), (d) risk-matched non-issuing firms in the IPO period, and (e) risk-matched non-issuing firms in the post-IPO period.

As a robustness check we examine institutional holdings data where we find additional evidence of selective buy-back of shares. Specifically, we find that the mean and median institutional holdings of IPO stocks at the end of the first calendar quarter immediately following the offer date is lower for cold IPOs than for hot IPOs.

[3]We are grateful to associates in the investment banking community for their comments that led us to this explanation.

Taken together, our results support the hypothesis that institutional investors, on average, are allowed to flip out of their allocations of cold IPO shares and get better price execution in the cold IPO aftermarkets. In addition, we find evidence that lead underwriters cover their short positions through *selective* buy-back of shares from institutions at the offer price during the stabilization period. The idea that lead underwriters provide selective price support in the stabilization period is consistent with Benveniste et al. (1996). Accounts in the popular press also indicate that the restrictions on flipping are not uniformly applied and retail clients are specifically under duress not to flip their allocations.[4]

Our finding is in contrast to Griffin et al. (2003) who, using proprietary Nasdaq data, examine the trading behavior of institutional and retail investors surrounding the Nasdaq bubble in the late 1990s and early 2000s. They find that institutions were no better at spotting the excessive price movements than retail investors. In fact, institutions tended to exhibit 'trend-chasing behavior' rather than moving against the market during this time period. In other words, Griffin et al. (2003) find that institutional investors do not represent the informed traders as we generally assume they do. If the Griffin et al. (2003) finding is more representative of what happens normally, then our contrasting result that institutional investors are informed traders in the IPO process serves to reinforce our claim that institutional investors get favored treatment from the lead underwriters in a cold IPO immediate post-issue aftermarket.

The remainder of the paper is organized as follows. The next section describes our sample and provides initial descriptive statistics. Section 2 examines the trading patterns in the stabilization period. Section 3 analyzes the information content of trades, and Section 4 presents the post-stabilization-period institutional holdings in cold IPOs, and Section 5 concludes.

1. Data

The study draws on IPOs from 1993 to 1998. We restrict our final sample to IPOs placed by seven lead investment banks who have high reputations (as proxied by market share) and have not undergone a merger, which allows us to assume a continuity of management and practices during our sample period. Prestigious underwriters, who bring multiple offerings to the market each year, must maintain good relations with their buy-side clients, who are continually called upon to purchase not only the issues in high demand but also cold issues that are difficult to sell. Thus, we focus on such prestigious underwriters to examine the possible preferential treatment of institutional clients who are regular large buy-side clients. Furthermore, as Ellis et al. (2005) point out, prestigious underwriters have greater ability to generate interest in an IPO through their distribution network and institutional investor contacts.

The population of U.S. IPOs with offer dates from 1993–1998 is extracted from the Securities Data Corporation's (SDC) database. The SDC is also used to collect information on the type of security offered, the offer date, the offer price, the proceeds

[4]See, for example, the following articles: "Flip side: Wall Street brokers press small investors to hold shares: Big institutions can cash out quickly; the 'Little Guy' can't without penalties" (*Wall Street Journal,* June 26, 1998) by Michael Siconolfi and Patrick McGeehan; and, "Wall Street boosts penalty on IPO Flips" (*Wall Street Journal*, July 31, 1998) by Michael Siconolfi and Patrick McGeehan.

Table 1
Average size of sample and population IPO in million of dollars
This table shows the average IPO size lead-underwritten by seven investment banks—Bear Sterns and Co., CS First Boston, Donaldson, Lufkin & Jenrette, Goldman Sachs, Hambrecht & Quist, Lehman Brothers, and Merrill Lynch–during the 1993–1998 period (our sample), compared to the average IPO size lead-underwritten by all investment banks in the same period.

	Sample ($ millions)	Population ($ millions)
1993	54.80	57.31
1994	49.71	39.59
1995	65.90	64.16
1996	82.82	59.64
1997	67.70	67.65
1998	75.54	77.74
Overall	68.21	60.33
Median	44.05	30.00
Maximum	408.80	3,025.00
Minimum	5.50	0.07

of the offering, the original high and low estimated offer prices, and the name of the managing underwriter.

The Center for Research in Securities Prices (CRSP) database is then used to gather stock returns and additional information about the security issued. Securities that are not clearly identified on CRSP are deleted from the sample, as are financial companies, reverse LBOs, spinoffs, unit offerings, limited partnerships, ADRs, small offerings (less than $5 per share or $5 million in global proceeds), foreign corporations, and observations with missing data.[5]

Using the selection criteria described above, our final sample is comprised of 428 IPOs lead underwritten by seven investment banks–Bear Sterns and Co., CS First Boston, Donaldson, Lufkin & Jenrette, Goldman Sachs, Hambrecht & Quist, Lehman Brothers, and Merrill Lynch—during the years 1993 through 1998. Table 1 compares the average IPO size in millions underwritten by our sample of seven investment banks to that underwritten by all investment banks between 1993 through 1998.

As can be seen in Table 1, the mean size of IPOs underwritten by our sample of investment banks is approximately $68 million, about $8 million larger than that underwritten by all investment banks over the same period. This is not surprising given our focus on the large, more liquid issues typically offered by the more prestigious investment banks.

Table 2 shows the proportion of hot, within-range and cold IPOs lead underwritten by each of these seven investment banks from 1993 to 1998. In line with Benveniste and Spindt (1989), Hanley (1993), and Ritter (1998), we define hot and cold IPOs relative to the

[5]Researchers investigating IPOs typically delete REITs and closed-end funds from their sample (see Bradley et al. 2003). For our main sample, we delete REITs, closed-end funds, as well as all other financial companies (e.g., banks, savings and loans, insurance companies). Stocks with an offer price below $5 are subject to the provisions of the Securities Enforcement and Penny Stock Reform Act of 1990, aimed at reducing fraud and abuse in the penny stock market (Ritter, 1998). IPOs raising less than $5 million may register under Regulation A, which has the least stringent disclosure requirements (Ritter, 1998).

Table 2
Sample composition

This table shows the proportion of hot, within-range and cold IPOs lead managed by the seven underwriters—Bear Sterns and Co., CS First Boston, Donaldson, Lufkin and Jenrette, Goldman Sachs, Hambrecht and Quist, Lehman Brothers, and Merrill Lynch—during the years 1993 through 1998 that form our sample. Hot, within-range and cold IPOs are defined in terms of pricing above the indicated price range, within the indicate price range and below the indicated price range respectively.

Lead underwriter	Number of IPOs	Hot(%)	Within-range(%)	Cold(%)
Bear, Stearns and Co.	34	27	29	44
CS First Boston	37	11	57	32
Donaldson, Lufkin & Jenrette	71	27	46	27
Goldman, Sachs & Co.	85	55	35	10
Hambrecht & Quist	94	25	46	29
Lehman Brothers	53	21	36	43
Merrill Lynch & Co	54	30	50	20
All	428	30	43	27

original price range filed with the Securities Exchange Commission (SEC). Specifically, this information is taken from the "red herring," or preliminary prospectus, filed with the SEC that includes the IPO's registration statement, the initial high and initial low price range for the offering. The investment bankers start their book-building exercise with the preliminary prospectus and, thus, these high and low file prices represent the underwriter's "bona fide estimate of the final offer price" (Hanley, 1993, p. 233). We refer to the offers priced above the filing range, i.e., where the offer price is greater than the high file price, as "hot" IPOs; to the offers priced below the low file price as "cold"; and to those priced within the range (including those priced at the high or low) as "within-range."

In our sample, Hambrecht and Quist and Goldman Sachs managed the largest number of IPOs (94), while Bear Stearns and CSFB managed the smallest number of offers at 34 and 37, respectively. In terms of the hot and cold categories, a significant portion of the IPOs do not price within the initial price range—30 percent of the IPOs price above the range and are classified as hot IPOs and 27 percent price below the range and are classified as cold IPOs. There are, however, noticeable differences among the seven prestigious investment banks included in the sample. For example, the relative range for hot IPOs is 11 percent (CS First Boston) to 55 percent (Goldman, Sachs & Co.); while the relative range for cold IPOs is 10 percent (Goldman, Sachs & Co.) to 44 percent (Bear, Stearns and Co.).

In order to extract the information content of aftermarket trades, our analysis relies on transaction data from NYSE's Trade and Quote (TAQ) databases. Table 3 shows the distribution of trade direction and size for the hot, within-range and cold IPOs in our sample. The direction of a trade is determined using the Lee and Ready (1991) rule. All eligible trades are paired with eligible quotes that were posted at least five seconds before the trade in question and signed as either a *buyer-initiated* or *seller-initiated* trade using the "quote" method for non-midpoint trades and the "tick" method for mid-point trades. The "quote" method classifies a trade as a buyer-initiated trade if the trade occurs at a price that is above the midpoint of the associated quote and classifies it as a seller-initiated trade if the trade occurs at a price that is below the midpoint of the associated quote. The "tick" method treats the mid-point trades; a mid-point trade is considered a buy if the last non-zero price change was positive and a sell if the last non-zero price change was negative.

Table 3
Trade direction and size

This table shows the distribution of institutional, medium size, and retail trades for the hot, within-range and cold IPOs in our sample, and the average trade size.

	Cold(%)	Within-range(%)	Hot(%)
Percentage of trades			
Large sells	10	10	6
Large buys	5	7	5
Medium sells	31	27	25
Medium buys	25	23	23
Small sells	13	16	21
Small buys	16	17	20
Average trade size			
Large sells	31,835	29,022	20,916
Large buys	21,680	23,599	22,119
Medium sells	3,059	3,080	2,942
Medium buys	2,735	2,895	2,794
Small sells	412	379	350
Small buys	364	352	346

We determine bulk trades as follows: we first aggregate all sequential trades that occur at the same price on the same side of the market without any change in the bid or ask quotes and treat them as a single order. The reason for aggregation is that a large order may be negotiated at a single price but reported as a series of smaller trades or a large limit order may be executed at a single price against several incoming market orders.[6]

Trades are also classified by size in an effort to identify trades initiated by institutional investors. Following Krigman et al. (1999), we classify *large* trades (greater than 10,000 shares) as institutional transactions. Aggarwal (2003) also shows that the median institutional flipped trade size is 11,922 shares.[7] *Small* trades (less than 1,000 shares) are classified as retail transactions. Trades that are between 1,000 and 10,000 shares can either be small institutional transactions or large retail transactions, and are therefore classified as *medium* transactions.

As Table 3 shows, for both cold and hot IPOs over 50 percent of trades are seller-initiated in the stabilization period. However, large seller-initiated trades are more prevalent in cold IPOs (10 percent) than in hot IPOs (6 percent). Furthermore, the average trade size of a large seller-initiated trade in a cold IPO is 31,835 shares compared to 20,916 shares in a hot IPO. Other trade size comparisons appear comparable between cold and hot IPOs.

The data presented above offer the following conclusions. First, not all IPOs are priced within or above the initial filing range—a significant portion of IPOs are low demand or

[6]The results of this article are also estimated without this aggregation algorithm. These results are not presented in the paper but are available by request. The aggregation algorithm does not result in material differences in the results.

[7]As a robustness check, we estimate the results using different definitional breakpoints for large trades. Specifically we modify large trades to include all trades greater than 7,500 shares as well 5,000 shares. These modifications do not change our conclusions.

cold offering. Second, consistent with Argawal (2000), institutional investors appear disproportionately to flip cold IPOs relative to hot IPOs.

2. Trade patterns in the stabilization period

In this section, we establish that not all sells are supported at the offer price during the stabilization period of cold IPOs. In our sample, a much higher proportion of institutional sells are supported at the offer price, while a much higher proportion of retail sells take place below the offer price.

The graphs in Fig. 1 depict these results by focusing on sell trades that occur at or below the offer price during the stabilization period for cold IPOs. The results are presented over three time periods; the first day of trading, the first five days of trading and the first twenty days of trading.[8] Panel A presents the conditional proportions of institutional and retail sells that occur at and below the offer price. As is strikingly revealed in the bar chart, a higher proportion of institutional sells occur at the offer price (shown by the first three pairs of bars), and a higher proportion of retail sells occur below the offer price (as seen in the last three pairs).

The figure in the lower panel, Panel B, plots the number of shares sold by institutions at the offer price as a percentage of the offer size, averaged over all cold IPOs in our sample. The number of institutional sell shares supported at the offer price is 2%, 5% and 16% of the offering size after day 1, day 5, and day 20, on an average across all cold IPOs. These numbers, taken in conjunction with Aggarwal's (2000) finding that the short position covered in cold IPO aftermarkets is 16% of the offering size, suggest that lead underwriters cover their short positions through selective buy-back of shares from institutions at the offer price in the stabilization period. They allow some institutional sells and a significant proportion of retail sells to fall through the stabilization floor.

3. Asymmetric information content of trades

In this section, we develop our empirical tests for the information content of trades and discuss our results. We find that the information content of large seller-initiated trades during the cold IPO stabilization period is the *lowest* compared to that of small seller-initiated trades, as well as, that of large sells of hot IPOs, medium demand IPOs, and several control samples. This result is consistent with our initial hypothesis that the information content for cold IPOs will be the lowest because bulk flipped sells are anticipated by the lead underwriter and therefore prices do not adjust in response to their arrival.

3.1. Measuring the information content of trades: empirical specifications

The asymmetric information component of a trade is determined using microstructure measures from the bid-ask spread literature. These measures are derived from trade based models and are designed to measure the compensation the market maker receives for transacting with potentially better informed traders. In total, we estimate five different

[8]Overall 71%, 60%, and 53% of all institutional sells and 43%, 42%, and 39% of all retail sells take place at or below the offer price in the 1-day, 5-days, and 20-days period after cold IPOs.

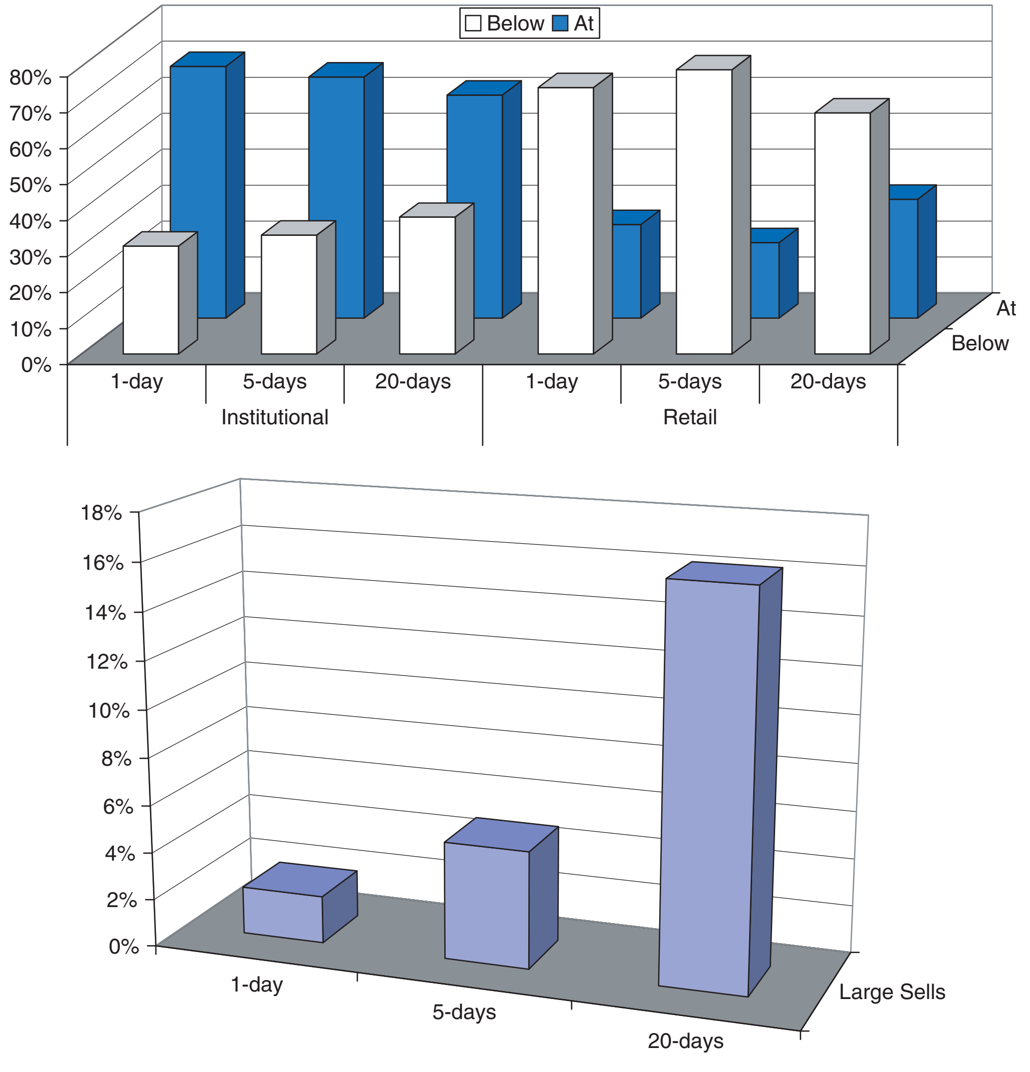

Fig. 1. Panel A: seller-initiated trade execution prices relative to offering price for trades that take place at or below the offer price for cold IPOs. Overall 71%, 60%, and 53% of all institutional sells and 43%, 42%, and 39% of all retail sells take place at or below the offer price in the period 1-day, 5-days, and 20-days after cold IPOs. This figure shows the proportions of institutional and retails sells that occur at or below the offer price out of all institutional or retail sells that occur at or below the offer price during the stabilization period for cold IPOs. The proportion of institutional sells at the offer is significantly bigger than the proportion of retail sells at the offer, at the 5% significance level in all 3 time periods. Panel B: The number of shares sold in bulk trades at the offer price as a proportion of the offer size, averaged over all cold IPOs in our sample, 1-day, 5-days, and 20-days after the issue.

measures of asymmetric information—the quoted bid-ask spread, the Huang and Stoll (1997) (HS) 2-way model, the HS 3-way model, the Madhavan et al. (1997) (MRR) model, and the restricted HS 3-way model. Each of these asymmetric measures is briefly described below.

Quoted bid-ask spread. The quoted bid-ask spread is the simplest measure of asymmetric information. Microstructure theory predicts that the bid-ask spread will reflect the size of the asymmetric information component of a trade. Specifically, when there is a large degree of asymmetric information, the bid-ask spread will be relatively large in order to compensate market makers for trading with potential informed investors. Mathematically, the quoted bid-ask spread is defined as:

$$AI_t^1 = Bid_t - Ask_t, \tag{1}$$

where AI^1 represents our first asymmetric information estimate, the quoted bid-ask spread. We will estimate AI^1–AI^5 in this paper.

HS 2-way model. The HS 2-way model is given by:

$$\Delta P_t = \lambda \frac{S}{2} Q_{t-1} + \frac{S}{2} \Delta Q_t + e_t, \tag{2}$$

where ΔP_t is the price change between trades at time t and $t-1$, S is the constant spread, Q_t is the trade direction indicator at time t that takes the value of $+1$ if the transaction is buyer-initiated and -1 if the transaction is seller-initiated, and λ is the proportion of the half-spread that is due to inventory holding and asymmetric information costs. The model is unable to distinguish between the inventory holding and asymmetric information costs, and therefore λ is used to estimate the asymmetric information component of a trade. The asymmetric information component of each trade is extracted using the estimated parameters. Specifically, for each trade, an estimate of the asymmetric information component of the trade is extracted from the trading history as:

$$AI_t^2 = \hat{\lambda} \frac{\hat{S}}{2} Q_t \tag{3}$$

where AI_t^2 is the HS 2-way asymmetric information component of Q_t, or in other words of trade t, $\hat{\lambda}$ is the estimated asymmetric information component of a trade from Eq. (2) and $\hat{S}$ is the estimated constant spread also from Eq. (2).

HS 3-way model. The HS 3-way model distinguishes inventory-holding costs from the asymmetric information costs. These cost components are separated by modeling the asymmetric information cost component to depend on the extent to which actual trade directions differ from expected trade directions, and modeling the inventory-carrying cost component to depend on the history of actual trade directions. This model is given by:

$$\begin{aligned} &\mathrm{E}\left[Q_{t-1} \middle| Q_{t-2}\right] = (1-2\pi) Q_{t-2} \\ &\Delta M_t = (\alpha+\beta) \tfrac{S_{t-1}}{2} Q_{t-1} + \alpha \tfrac{S_{t-2}}{2} (1-2\pi) Q_{t-2} + e_t, \end{aligned} \tag{4}$$

where M_t is the mid-quote at time t or the average of the bid and ask prices at time t, S_t is the quoted spread at time t, α is the fixed proportion of half-spread due to asymmetric information and β the fixed proportion of half-spread due to the inventory-carrying cost. The asymmetric information component of each trade is forecasted using the estimated parameters from the HS 3-way model. Specifically, for each trade, an estimate of the asymmetric information component of the trade is forecasted as:

$$AI_t^3 = \hat{\alpha} \left(\frac{S_t}{2} Q_t + \frac{S_{t-1}}{2} (1 - 2\hat{\pi}) Q_{t-1} \right) \tag{5}$$

where AI_t^3 is the HS 3-way asymmetric information component of Q_t, and $\hat{\alpha}$ is the estimated asymmetric information component of a trade from Eq. (4).

MRR model. The MRR model separates out asymmetric information from the aggregate of order processing and inventory carrying costs, and is given by:

$$\begin{aligned} Q_t &= \rho Q_{t-1} \\ \Delta P_t &= (\phi + \lambda)Q_t - (\phi + \rho\lambda)Q_{t-1} + \varepsilon_t, \end{aligned} \tag{6}$$

where λ is the asymmetric information cost, ϕ is the aggregate of order processing and inventory carrying costs, and ρ is the first order autocorrelation of the trade indicator variables, Q_t and Q_{t-1}. For each trade, an estimate of the asymmetric information component using the MRR model is forecasted as:

$$AI_t^5 = \hat{\lambda}\left(\mathrm{Q}_t - \hat{\rho}Q_{t-1}\right), \tag{7}$$

where AI_t^5 is the MRR asymmetric information component of trade t, and $\hat{\lambda}$ is the estimated asymmetric information component of a trade from Eq. (6).

Restricted HS 3-way model. Because of its ability to separate out asymmetric information, inventory holding costs and order processing costs, the HS 3-way model is the most advanced model of asymmetric information discussed so far. Theoretically, all three of these costs are strictly positive. However, estimation of the model may yield negative estimates of asymmetric information or inventory-holding costs as documented in Clarke and Shastri (2000) and Krishnan (2005). Indeed, we find that approximately half the eligible data sample could not be used due to negative parameter estimates of asymmetric information and/or inventory holding cost components using the HS 3-way model. Therefore, we re-estimate the asymmetric information cost component from the HS 3-way model by simultaneously imposing the restriction that the inventory carrying cost component and the adverse selection cost proportions of spread are bound between 0 and 1. The restricted HS 3-way model, thus, allows us to use almost the entire trade data sample.

3.2. *Trade data samples: summary statistics of asymmetric information measures*

To compute the average microstructure estimates of our five measures of asymmetric information we first split our IPO sample into three sub-groups: hot IPOs, within-range IPOs, and cold IPOs and conduct our analysis over a 20 day post-issue stabilization period. The three groups were chosen to allow us to compare the asymmetric information component of cold IPOs with that of both hot and within-range IPOs over the price stabilization period. Regarding our choice of a 20-day stabilization period, we wanted to cover the period in which the lead underwriter functions as the primary market maker. Several studies, such as Ellis et al. (2000) and Aggarwal et al. (2002), have determined that that the stabilization period is complete 20 trading days after the public offering and we, therefore, use this time frame in our analysis.

To examine the robustness of the results, the research design is augmented to include several control groups. Specifically, we also exam the post-IPO stabilization period, as well as, a sample of matched firms over the IPO period and post-IPO period. The post-stabilization period for our sample allows us to examine the change in the asymmetric information component for the seller-initiated trades by including data one year after the stabilization sample period. Consistent with our hypothesis, we would expect the asymmetric component for cold IPOs to increase from the stabilization period to the post-stabilization period.

To consider the possibility that changes in the information component are due to sample selection or market conditions, we also introduce a sample of matched firms. The matched sample is constructed by matching the size and book to market for each IPO firm to a non-issuing firm (see Barber and Lyon (1997) for reasons for using a risk matched non-issuing firm, and Ritter (2000) for the characteristics used for risk matching). For the IPO firm, we compute size (as determined by the market value of equity) as of the first CRSP trading day following the IPO, and the book-to-market ratio as of the end of the month immediately before (if available) or immediately after the IPO date. For our reference set of non-issuing firms, we compute the size and the book-to-market ratio as of dates that are as close as possible to the dates in which these figures were calculated for the IPO firm. The information content of the stabilization-period-large sells of cold IPOs should again be smaller than that of the matched sample if there is a tacit understanding between the lead underwriter and institutional investors flipping the shares. Therefore, we examine (a) trades for the same IPO firms during a post-stabilization period (one-year after the IPO) and (b) trades of risk-matched non-issuing firms during the IPO stabilization as well as the post-stabilization period.

Summary statistics for our five different measures of asymmetric information are reported in Table 4. These measures include: (1) the average quoted bid-ask spread, and the average asymmetric information component of the bid-ask spread using; (2) the HS 2-way model; (3) the HS 3-way model; (4) the MRR model; and (5) the restricted HS 3-way model. The results are presented by sample (IPO sample vs. matched sample) and by period (IPO/stabilization period, post-IPO period). Panel A summarizes the results for the IPO sample over the stabilization period; Panel B shows the IPO sample over the post-stabilization period; Panel C reports the matched-firm sample for the stabilization period; and, Panel D reports the matched firm sample for the post-stabilization period.

The number of observations possible for each measure is listed in the second column, while the actual number of observations used for the specific measure of asymmetric information is listed below the estimate in columns three through seven. Observations were dropped from the analysis if fewer than 100 trades were executed over the sample period and if the parameter estimates were inconsistent with the theoretical models. The effect of reducing the sample is most evident with the HS 3-way model. For example, in Panel A, there are 428 identified IPOs over the sample period. Of these, only 240 result in reliable parameter estimates for asymmetric information using the HS 3-way model. The restricted HS 3-way is estimated to address possible sample size issues.

Overall, Table 4 shows that for our sample of IPOs (see Panels A and B), all five measures of asymmetric information are lower in the stabilization period than in the post-stabilization period. These results support the hypothesis that some trades are anticipated immediately following an IPO. For the matched sample, shown in Panels C and D, the quoted spread is, on average, lower in both time periods than the spread for the IPO sample. However, from lowest to highest, the other four measures of asymmetric information content of trades suggest that the information content of stabilization period trades for the IPO sample is the lowest, the IPO sample in the post-stabilization period is second, the matched-firm trades in the stabilization period is third, and the matched firm trades in the post-stabilization period is last (or, in other words, has the most information

Table 4
Summary statistics

This table reports the average of the various market microstructure measures of information asymmetry for our sample by year and overall. These measures include the quoted bid-ask spread, the asymmetric information component of the bid-ask spread using the Huang and Stoll (1997) 2-way decomposition, the asymmetric information component of the bid-ask spread using the Huang and Stoll 3-way decomposition as well as a restricted version of the Huang and Stoll 3-way decomposition and the Madhavan et al. (1997) measure of the asymmetric information component of the bid-as spread. The restricted Huang and Stoll 3-way decomposition bounds the asymmetric information component between 0 and 1.

	N	Quoted spread	HS-2-way	HS-3-way	MRR	HS-3 way (Restricted)
Panel A. IPO sample period. These microstructure measures are estimated for the IPO sample using trades executed in the first 20 days of trading after the public offering						
1993	68	\$0.378 ($n=65$)	36.67% ($n=64$)	2.36% ($n=39$)	23.16% ($n=64$)	1.65% ($n=63$)
1994	50	\$0.373 ($n=43$)	41.57% ($n=43$)	4.60% ($n=19$)	26.89% ($n=43$)	2.49% ($n=41$)
1995	78	\$0.398 ($n=77$)	37.51% ($n=63$)	2.63% ($n=51$)	21.64% ($n=77$)	1.97% ($n=74$)
1996	117	\$0.334 ($n=113$)	43.94% ($n=93$)	3.92% ($n=65$)	23.50% ($n=113$)	2.64% ($n=113$)
1997	68	\$0.248 ($n=68$)	41.60% ($n=68$)	6.63% ($n=40$)	30.86% ($n=68$)	4.48% ($n=68$)
1998	47	\$0.186 ($n=47$)	29.56% ($n=47$)	6.57% ($n=26$)	20.62% ($n=47$)	5.13% ($n=47$)
Overall	428	\$0.326 ($n=413$)	35.29% ($n=412$)	4.18% ($n=240$)	24.34% ($n=412$)	2.94% ($n=406$)
Panel B. Post-IPO sample period. These microstructure measures are estimated for the IPO sample using trades executed in the 20 days of trading one year after the public offering						
1993	68	\$0.408 ($n=40$)	38.07% ($n=37$)	3.17% ($n=20$)	26.90% ($n=37$)	2.52% ($n=34$)
1994	50	\$0.412 ($n=34$)	41.25% ($n=32$)	6.61% ($n=11$)	32.31% ($n=33$)	3.64% ($n=30$)
1995	78	\$0.416 ($n=63$)	37.51% ($n=63$)	4.93% ($n=20$)	31.28% ($n=63$)	4.21% ($n=58$)
1996	112	\$0.304 ($n=95$)	43.94% ($n=93$)	8.64% ($n=40$)	40.38% ($n=94$)	5.56% ($n=86$)
1997	68	\$0.272 ($n=64$)	41.99% ($n=62$)	10.83% ($n=11$)	44.65% ($n=62$)	5.31% ($n=55$)
1998	44	\$0.214 ($n=41$)	28.65% ($n=41$)	6.61% ($n=12$)	24.43% ($n=41$)	4.89% ($n=41$)
Overall	420	\$0.331 ($n=337$)	39.50% ($n=328$)	6.83% ($n=114$)	35.15% ($n=330$)	4.64% ($n=304$)
Panel C. Matched firm IPO sample period. These microstructure measures are estimated for a sample of matched firms using trades executed in the same 20 day period of trading for corresponding or matched IPO firm						
1993	60	\$0.314 ($n=36$)	50.61% ($n=32$)	3.56% ($n=17$)	37.50% ($n=32$)	3.39% ($n=30$)
1994	50	\$0.251 ($n=30$)	63.10% ($n=28$)	14.45% ($n=10$)	50.46% ($n=28$)	5.72% ($n=23$)
1995	77	\$0.273 ($n=49$)	52.27% ($n=49$)	5.69% ($n=16$)	42.63% ($n=49$)	4.75% ($n=46$)
1996	96	\$0.283 ($n=75$)	55.76% ($n=73$)	6.45% ($n=23$)	51.23% ($n=73$)	4.30% ($n=68$)
1997	63	\$0.243 ($n=54$)	55.43% ($n=53$)	10.57% ($n=18$)	48.61% ($n=53$)	5.89% ($n=48$)
1998	42	\$0.223 ($n=35$)	53.10% ($n=35$)	8.84% ($n=11$)	51.92% ($n=35$)	6.79% ($n=34$)
Overall	388	\$0.266 ($n=279$)	54.87% ($n=270$)	7.70% ($n=95$)	47.54% ($n=270$)	5.05% ($n=249$)
Panel D. Matched firm post-IPO sample period. These microstructure measures are estimated for a sample of matched firms using trades executed in the same 20 day period of trading for corresponding or matched IPO firm one year after the public offering						
1993	57	\$0.298 ($n=37$)	49.21% ($n=37$)	6.63% ($n=17$)	39.62% ($n=37$)	3.70% ($n=30$)
1994	46	\$0.208 ($n=28$)	59.63% ($n=27$)	8.98% ($n=10$)	47.23% ($n=27$)	6.95% ($n=23$)
1995	75	\$0.262 ($n=52$)	52.81% ($n=52$)	7.38% ($n=20$)	41.74% ($n=52$)	6.33% ($n=46$)
1996	101	\$0.296 ($n=88$)	57.91% ($n=81$)	9.28% ($n=14$)	52.45% ($n=82$)	5.21% ($n=75$)
1997	65	\$0.229 ($n=57$)	58.20% ($n=55$)	20.14% ($n=15$)	54.44% ($n=56$)	9.32% ($n=51$)
1998	43	\$0.200 ($n=39$)	58.01% ($n=39$)	17.71% ($n=17$)	54.61% ($n=39$)	11.75% ($n=36$)
Overall	387	\$0.257 ($n=301$)	56.12% ($n=291$)	11.08% ($n=93$)	49.12% ($n=293$)	9.03% ($n=261$)

Table 5
Asymmetric information content of large sell trades by IPO type

This table decomposes the microstructure measures of asymmetric information for large trades by the demand of the IPO and sample periods. Large trades are defined as trades in excess of 10,000 shares. The demand for an IPO is determined by the relationship of the offering price to the initial pricing range. Offerings priced above the range are labeled as hot, offerings priced within the range are labeled within-range and offerings below the initial pricing range are labeled cold. Control 1 represents IPO firms in the post-IPO period (one year after the offering), Control 2 represents the matched firms in the IPO period, and Control 3 represents matched firms in the post-IPO period. ***, **, * respectively denote difference with cold significant at the 1%, 5%, and 10% level.

		HS-3 way (Restricted)	
Large sell trades	Hot	\$0.0030	**
	Within	\$0.0025	
	Cold	*\$0.0019*	
	Control 1	\$0.0052	***
	Control 2	\$0.0048	***
	Control 3	\$0.0066	***

content of trades). Since these four measures of asymmetric information yield consistent results and the HS 3-way model is the most sophisticated, we report the restricted HS 3-way model results henceforth in the paper. However, we present results from the other models using these alternate measures in the Appendix.

Using our preferred measure of asymmetric information (HS-3 way), one of our objectives is to compare formally the information content of bulk flipped trades of cold IPOs during the stabilization period with that of small trades as well as with other large seller-initiated trades. Again, it is likely that large sells and bulk sells originate from institutional investors, while small trades are more likely retail trades. Table 5 presents the asymmetric information summary statistics for large seller-initiated trades for each of the sample groups. Large sells in the IPO stabilization period can belong to hot IPOs (*HOT*), within-range IPOs (*WITHIN*) or cold IPOs (*COLD*). We also consider large sells of three control samples for comparison purposes. These control samples are either large sells of the same IPO firms during the 20-day period one-year after the IPO (*CONTROL1*); large sells of risk matched non-issuing firms during the IPO stabilization period of the issuer (*CONTROL2*); or large sells of risk matched non-issuing firms one-year after the IPO (*CONTROL3*).

As can be seen in italics, the asymmetric information component of large stabilization period sells of cold IPOs is the lowest. This measure, at \$0.0019, is smaller than all five comparison groups and this difference is statistically significant for four comparisons (trades of hot IPOs, and trades of CONTROL 1, CONTROL 2, and CONTROL 3 samples).

3.3. Regression models

To test more formally for statistically significant differences in these asymmetric information measures, we estimate regression models that allow us to control for other variables that might also have an impact on the information content of trades in our sample over this time period. In the spirit of Dennis and Weston (2001), we control for a variety of factors which may influence the information content of a trade. The specific control variables included in the regression model are as follows. VOLUME_i is defined as the total number of shares transacted over the 20-day IPO stabilization or control period for firm i, and is included to control for liquidity. However, even if a stock has low volume, it could still be considered liquid if its volume is high relative to the number of shares outstanding (turnover), so we also control for turnover. Specifically, TURNOVER_i is the volume traded divided by the number of shares outstanding for the 20-day IPO stabilization or control period. We also include a volatility control, VOLATILITY_i, defined as the standard deviation of daily returns over the 20-day IPO stabilization or control period, since volatility can influence the spreads the market maker sets. Lastly, we include two dummy variables, NASDAQ_i and AMEX_i, to allow for separate effects for the exchange in which the stock trades. If both dummies are zero, then the stock trades at NYSE. Using a combination of alternative pooled samples, we estimate the following four models (Model A, Model B, Model C, and Model D).

Model A: Model A is a cross-sectional regression for the IPO sample during the IPO period:

$$\begin{aligned} AI_i^j = {} & \beta_0 + \beta_1 \text{VOLUME}_i + \beta_2 \text{TURNOVER}_i + \beta_3 \text{VOLATILITY}_i \\ & + \beta_4 \text{NASDAQ}_i + \beta_5 \text{AMEX}_i \\ & + LS_i * \left(\beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i\right) \\ & + LB_i * \left(\beta_9 HOT_i + \beta_{10} WITHIN_i + \beta_{11} COLD_i\right) \\ & + M_i * \left(\beta_{12} HOT_i + \beta_{13} WITHIN_i + \beta_{14} COLD_i\right) \\ & + \varepsilon_i, \end{aligned} \tag{8}$$

where AI_i^j is the average asymmetric information component of bid-ask spread using the restricted HS 3-way model for firm i, LS_i, LB_i, and M_i are indicator variables that take the value 1 for large seller-initiated trades, large buyer-initiated trades and medium sized trades respectively for firm i, while *HOT*, *WITHIN* and *COLD* are indicator variables that take the value 1 for hot, within-range and cold IPOs during the IPO stabilization period and 0 otherwise. Thus, the coefficients β_6, β_7 and β_8 are measured relative to small NYSE trades, the omitted indicator variable.

Of particular interest is the estimated parameter for cold IPOs relative to that for hot IPOs, and within-range IPOs. Our hypothesis suggests that the estimated parameter, β_8, should be smaller than β_6 and β_7, or in other words, the asymmetric information component for large seller-initiated trades should be smaller for cold IPOs than for other IPOs.

Model B: Model B is also a cross-section regression that includes trade data for a 20-day period one-year after the issue (i.e., same IPO firm in a non IPO period) in addition to the IPO sample during the IPO period (estimated alone in Model A):

$$\begin{aligned} AI_i^j = {} & \beta_0 + \beta_1 \text{VOLUME}_i + \beta_2 \text{TURNOVER}_i + \beta_3 \text{VOLATILITY}_i \\ & + \beta_4 \text{NASDAQ}_i + \beta_5 \text{AMEX}_i \\ & + LS_i * \left(\beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i + \beta_9 CONTROL1_i\right) \\ & + LB_i * \left(\beta_{10} HOT_i + \beta_{11} WITHIN_i + \beta_{12} COLD_i + \beta_{13} CONTROL1_i\right) \\ & + M_i * \left(\beta_{14} HOT_i + \beta_{15} WITHIN_i + \beta_{16} COLD_i + \beta_{17} CONTROL1_i\right) \\ & + \varepsilon_i, \end{aligned} \tag{9}$$

where *CONTROL1* is an indicator variable that takes the value 1 for the IPO firm in the non-stabilization period and 0 otherwise. Thus, this model allows us to examine the relationship of cold IPOs during the price stabilization period and post-stabilization period. Consistent with our hypothesis, we expect the estimated parameter, β_8, to be smaller than β_9, β_6, and β_7. Again, the coefficients β_6 through β_{17} are measured relative to small NYSE trades, the omitted indicator variable.

Model C: Model C focuses on the IPO stabilization period and includes the matched sample of non-issuing firms. In other words, this specification is a cross-sectional regression for the IPO sample during the IPO period and for a matched sample of non-issuing firms during the IPO stabilization period of the matched issuer:

$$\begin{aligned} AI_i^j = {} & \beta_0 + \beta_1 \mathrm{VOLUME}_i + \beta_2 \mathrm{TURNOVER}_i + \beta_3 \mathrm{VOLATILITY}_i \\ & + \beta_4 \mathrm{NASDAQ}_i + \beta_5 \mathrm{AMEX}_i \\ & + LS_i * \left(\beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i + \beta_9 CONTROL2_i\right) \\ & + LB_i * \left(\beta_{10} HOT_i + \beta_{11} WITHIN_i + \beta_{12} COLD_i + \beta_{13} CONTROL2_i\right) \\ & + M_i * \left(\beta_{14} HOT_i + \beta_{15} WITHIN_i + \beta_{16} COLD_i + \beta_{17} CONTROL2_i\right), \\ & + \varepsilon_i \end{aligned} \tag{10}$$

where *CONTROL2* is an indicator variable that takes the value 1 for the risk-matched firm in the IPO stabilization period and 0 otherwise. The hypotheses of interest are the relationship of cold IPOs to the matched-firm control group as well as to the hot and within-range IPOs. Again, we expect the estimated parameter, β_8, to be smaller than β_9, β_6 and β_7.

Model D: Model D is a pooled cross-sectional regression for both the IPO sample and the risk-matched non-issuing firm sample for both the IPO and post-IPO periods:

$$\begin{aligned} AI_i^j = {} & \beta_0 + \beta_1 \mathrm{VOLUME}_i + \beta_2 \mathrm{TURNOVER}_i + \beta_3 \mathrm{VOLATILITY}_i \\ & + \beta_4 \mathrm{NASDAQ}_i + \beta_5 \mathrm{AMEX}_i \\ & + LS_i * \begin{pmatrix} \beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i \\ +\beta_9 CONTROL1_i + \beta_{10} CONTROL2_i + \beta_{11} CONTROL3_i \end{pmatrix} \\ & + LB_i * \begin{pmatrix} \beta_{12} HOT_i + \beta_{13} WITHIN_i + \beta_{14} COLD_i \\ +\beta_{15} CONTROL1_i + \beta_{16} CONTROL2_i + \beta_{17} CONTROL3_i \end{pmatrix} \\ & + M_i * \begin{pmatrix} \beta_{18} HOT_i + \beta_{19} WITHIN_i + \beta_{20} COLD_i \\ +\beta_{21} CONTROL1_i + \beta_{22} CONTROL2_i + \beta_{23} CONTROL3_i \end{pmatrix} \\ & + \varepsilon_i, \end{aligned} \tag{11}$$

where *CONTROL3* is an indicator variable that takes the value 1 for the risk-matched firm during the post-stabilization period and 0 otherwise. In addition to testing the relationship of the cold IPO parameter estimate with the other parameter estimates, testing the equivalence of the parameters β_9 and β_{11} provides a further test of the appropriateness of the risk-matched firm sample by exploring similarity in the post-stabilization period between the two samples.

3.4. Asymmetric information regression results

Table 6 presents the regression results for the regression models A, B, C and D using the restricted HS 3-way measure of asymmetric information.[9] The test statistics at the bottom of the table provide tests for the equality of the asymmetric information component of large seller-initiated trades for cold IPOs with other large seller-initiated trades against the null hypothesis that the asymmetric information component of large seller-initiated trades for cold IPOs is less than that of other large seller-initiated trades.

Two observations can be made from the coefficient estimates presented in Table 6. First, the coefficient on the dummy variable for large IPO stabilization period sells for cold IPOs is negative. This coefficient is measured relative to the omitted variable: small NYSE trades. Thus, the information content of large (institutional) sells during the cold IPO stabilization period is *lower* than the information content of small (retail) trades.

Second, and more importantly, the coefficient on the dummy variable for large IPO stabilization period sells for cold IPOs is lower than the coefficient on the following dummy variables: (a) the large sells of hot IPOs; (b) the large sells of within-range IPOs; (c) the large sells of the same firms (IPO firms) one year after the IPO stabilization period (control sample 1); (d) the large sells of risk matched non-issuing firms in the same IPO stabilization period (control sample 2); and (e) the large sells of risk matched non-issuing firms in the one-year post-IPO period (control sample 3). These regressions all control for volume, turnover and volatility of the stock and the listing exchange. Furthermore, as shown in the lower panel of Table 6, the coefficient for the large cold IPO sells dummy variable is significantly lower than that of the large hot IPO sells, control sample 1, and control sample 2 dummy variables in most models.

In addition, these results are robust to alternative measures of asymmetric information presented earlier in the paper. As the Appendix shows, the information content of large sells during the cold IPO stabilization period is the *lowest* compared to these five comparison groups (a–e) using the HS 2-way model, the HS 3-way model, and the MRR model. The implication is that bulk sell orders in the cold IPO stabilization period are anticipated by the lead underwriter, met at the offer price, and used to cover the short position.[10]

4. Post-stabilization-period institutional holdings

Our evidence of the selective buy-back of shares from institutions implies that the immediate post-stabilization-period holdings of institutions would be lower for cold IPOs than for hot IPOs. In this section, we examine the post-stabilization period institutional holdings and find that the mean and median institutional holdings of IPO stocks are indeed lower for cold IPOs than for hot IPOs in the calendar quarter following an IPO.

[9]Only the coefficients of interest are presented.

[10]Ellis et al. (2005) point out that, in such studies, large trades could be inter-dealer trades (by market makers in Nasdaq managing their inventory) rather than trades originated by institutional investors. Without proprietary data, we cannot distinguish which large trades actually originate from institutional investors. However, Ellis, Michaely and O'Hara also find that such inter-dealer sales in the aftermarket constitute a smaller fraction of offerings for IPOs that priced below the initial filing range (cold IPOs) because market makers have smaller inventory positions in such offers.

Table 6
Asymmetric information regression results

This table reports the cross-sectional regression results of the various measures of asymmetric information on explanatory variables. The explanatory variables include average daily volume (*VOLUME*); share turnover (*TURNOVER*); the standard deviation of returns (*VOLATILITY*); and indicator variables for the listing exchange. For each asymmetric information measure, four models are estimated:

Model A: IPO sample from IPO period;
Model B: IPO sample from IPO period and post-IPO period;
Model C: IPO sample and matched sample from IPO period; and,
Model D: IPO sample and matched sample from IPO period and post-IPO period.

The regression specification is:

$$\begin{aligned} AI_i^j = {} & \beta_0 + \beta_1 \mathrm{VOLUME}_i + \beta_2 \mathrm{TURNOVER}_i + \beta_3 \mathrm{VOLATILITY}_i \\ & + \beta_4 \mathrm{NASDAQ}_i + \beta_5 \mathrm{AMEX}_i \\ & + LS_i * \begin{pmatrix} \beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i \\ +\beta_9 CONTROL1_i + \beta_{10} CONTROL2_i + \beta_{11} CONTROL3_i \end{pmatrix} \\ & + LB_i * \begin{pmatrix} \beta_{12} HOT_i + \beta_{13} WITHIN_i + \beta_{14} COLD_i \\ +\beta_{15} CONTROL1_i + \beta_{16} CONTROL2_i + \beta_{17} CONTROL3_i \end{pmatrix} \\ & + M_i * \begin{pmatrix} \beta_{18} HOT_i + \beta_{19} WITHIN_i + \beta_{20} COLD_i \\ +\beta_{21} CONTROL1_i + \beta_{22} CONTROL2_i + \beta_{23} CONTROL3_i \end{pmatrix} \\ & + \varepsilon_i, \end{aligned}$$

where AI_i^j is the average asymmetric information component of bid-ask spread using the restricted HS 3-way model for firm i, LS_i, LB_i, and M_i are indicator variables that take the value 1 for large seller-initiated trades, large buyer-initiated trades and medium sized trades respectively for firm i. Large sells in the IPO stabilization period can belong to hot IPOs (*HOT*), within-range IPOs (*WITHIN*) or cold IPOs (*COLD*). Large sells of the control samples are either large sells of the same IPO firms during the 20-day period one-year after the IPO (*CONTROL*1); large sells of risk matched non-issuing firms during the IPO stabilization period of the issuer (*CONTROL*2); or large sells of risk matched non-issuing firms during the post-stabilization period of the issuer (*CONTROL*3). None of *CONTROL*1, *CONTROL*2, or *CONTROL*3 appears in Model A, only *CONTROL*1 appears in Model B, only *CONTROL*2 in Model C, and all of *CONTROL*1, *CONTROL*2, or *CONTROL*3 in Model D. The coefficients associated with the different samples are relative to small NYSE trades. The test statistic for the significance of the difference between the coefficients of IPO period large cold IPO sells dummy variable and that of the dummy variables for the other large sells is shown.

The dependent variable is the asymmetric information component of the bid-ask spread using the restricted Huang and Stoll 3-way decomposition

		Model A	Model B	Model C	Model D
Intercept		0.0048	0.0069	0.0065	0.0077
		(16.38)	(22.97)	(20.10)	(26.89)
Volume		2.07E−10	−2.10E−10	−7.86E−10	−1.06E−09
		(0.37)	(0.60)	(2.43)	(3.58)
Turnover		−9.49E−07	−1.51E−06	−8.26E−07	−1.46E−06
		(0.61)	(0.67)	(0.34)	(0.48)
Volatility		2.34E−04	2.40E−03	−2.53E−03	−7.27E−04
		(0.18)	(2.77)	(2.51)	(1.01)
NASDAQ		−2.11E−03	2.68E−03	−2.92E−03	−3.26E−03
		(9.26)	(10.55)	(11.18)	(13.69)
AMEX		−9.87E−04	3.16E−04	2.22E-03	2.29E−03
		(1.04)	(2.78)	(3.71)	(4.22)
Large sell	Hot	0.00053	−0.00075	0.00006	−0.00107
		(1.43)	(1.45)	(0.11)	(1.57)

Table 6 (*continued*)

		Model A	Model B	Model C	Model D
	Within	0.00003	−0.00139	−0.00063	−0.00175
		(0.09)	(3.07)	(1.28)	(2.99)
	Cold	−0.00066	−0.00215	−0.00137	−0.00254
		(1.58)	(3.59)	(2.12)	(3.23)
	Control 1		0.00176		0.00128
			(4.67)		(2.70)
	Control 2			0.00139	−0.00002
				(3.04)	(0.04)
	Control 3				0.00211
					(4.04)
N		1,623	2,829	2,579	4,775
R^2		0.063	0.087	0.096	0.084
Coefficient restrictions					
Large sell hot = large sell cold	5.68**	3.57*	3.27*	2.21	
Within = large sell cold	2.20	1.19	0.99	0.72	
Control 1 = large sell cold		36.48***		19.40***	
Control 2 = large sell cold			14.41***	7.79***	
Control 1 = Control 3				1.67	

Institutional holdings data were extracted from the CDA Spectrum 13f Filings database for the sample of 428 IPOs examined above. Since all institutional investors managing a portfolio with an investment value of $100 million or more are required to file detailed quarterly 13f reports, we were able to gather information on equity positions for most of the IPOs in our database. Specifically, information on holdings was available if the institution held a position of greater than 10,000 shares or $200,000 in market value as of the last date of each quarter. As a result, we were able to match 424 of the 428 IPOs included in our sample.[11]

While Table 7 presents our best estimates of the post-flipped institutional holdings, these estimates are somewhat imprecise due to the monthly nature of the CDA dataset being matched with daily data. As a result of the mismatched timing of the two datasets, the day on which we link the institutional holdings data to our IPO data can be anywhere from 1 day to 90 days after the offer date and the results may be biased toward not finding a result if most of the flipping occurs in the period immediately following the IPO.

As can be seen in Table 7, we do find some evidence of differences in the institutional holdings, as a proportion of the number of shares offered, for the cold and hot IPOs. Both the mean and median institutional holdings of IPO stocks as at the end of the first calendar quarter immediately following an IPO are lower for cold IPOs as compared with hot IPOs. While institutions hold approximately 70 percent of shares of hot IPOs, they hold only 65 percent of shares offered for cold IPOs in the quarter immediately following the offering. The difference in the median proportion of approximately 7 percentage points is significant

[11]The missing data were for 2 cold and 2 hot IPOs.

Table 7
Institutional holdings

This table shows the institutional holdings as at the end of the first calendar quarter immediately following the offer date, for the Cold IPOs and the Hot IPOs from our sample of 428 IPOs. The institutional holdings data are taken from the CDA Spectrum 13f Filings database. All institutional investors managing a portfolio with an investment value of $100 million or more are required to file quarterly 13f reports to the SEC listing their equity positions greater than 10,000 shares or $200,000 in market value as of the last date of each quarter. The distributional statistics of the institutional holdings, as a proportion of the number of shares offered, for the cold and hot IPOs are reported. Also reported are the *p*-values measuring the significance of the differences of means and medians (Wilcoxon test). We could not get the 13f data from the spectrum database for the quarter end immediately succeeding the issue date for 2 cold IPOs and 2 hot IPOs. ***, **, * respectively denote significant difference from zero at the 1%, 5%, and 10% level.

13f institutional holdings				
		Cold	Hot	Difference (*p*-values)
Proportion of shares offered held by institutions	N	108	128	
	Mean	0.65***	0.70***	0.12
	Median	0.65***	0.72***	0.10
	Std. dev.	0.28	0.28	
	Min.	0.14	0.00	
	Max.	1.53	1.46	

at the 10 percent level and the difference in means is significant at the 12 percent significance level.

5. Conclusion

Investment bankers routinely take large naked positions in low-demand or cold IPOs and sell up to 135% of the shares offered by the firm going public. Although they are covered for the first 115% of the shares offered (including the over-allotment option), they are left with an apparently large naked short position. Following the initial placement, the restrictions on selling the allocated shares in the IPO-aftermarket back to the lead underwriter are not uniformly applied. Retail clients are under duress not to flip their allocations. On the other hand, institutional clients *are* allowed to flip their allocations. Krigman et al. (1999) find that large sells account for 45% of total dollar volume on the first day for cold IPOs and 22% for hot IPOs, despite significantly higher trading volume for the hot IPOs. We hypothesize that investment bankers provide institutional investors with an escape mechanism if they do not wish to retain their initial share allocations of cold IPOs because they are valuable buy-side clients involved in a repeated game.

The evidence we collect to support our hypothesis is in three parts. We document that the information content of large sells is lower for cold IPOs than for hot IPOs, and is lower than the information of small trades, and other control sample trades. Normally, large sell orders should evoke a response from the market maker in the form of wider spreads reflecting the information content of trades. Krigman et al. (1999) and Easley et al. (1996) taken together suggest that the information content of large sells must be *higher* for cold IPOs than for hot IPOs. And, from the market-microstructure literature, the information content of large sells must be *higher* than the information of small trades. Our findings are not consistent with either of these well-known results and we argue that this is so because the lead underwriter acting as the market maker anticipates bulk flipping in the cold IPO aftermarket.

It is possible that the lead underwriters deliberately suppress the information content of large sell-orders following cold IPOs to prevent negative cascades (see Welch, 1992). If all institutional trades were to occur at the stabilization price (the IPO's offer price), then we *would* expect the information content of such trades to be low. However, we document that there is no hard floor at the offer price (which is also the stabilization price) in the secondary market support for cold IPOs. In the 20-day stabilization period for cold IPOs, approximately 38% of large-sell trades and 67% of small-sell trades occur below the offer price. The number of shares sold in bulk trades supported at the offer price during the stabilization period as a proportion of the offer size is on average 16% for cold IPOs. In addition, the proportion of bulk sells supported at the offer price is significantly higher than the retail sells: 62% of large-sell trades and 33% of small-sell trades are supported at the offer price in the 20-day stabilization period. These numbers, taken in conjunction with Aggarwal's (2000) finding that the shares purchased by the lead underwriters in the cold IPO aftermarkets are 16% of the offering size, suggest that lead underwriters cover their short positions through *selective* buy-back of shares from institutions at the offer price in the stabilization period.

If institutional investors are allowed to flip back their allocations at the offer price during the stabilization period of cold IPO, we should find that the immediate post-stabilization period institutional holdings are lower for cold IPOs than for hot IPOs. Indeed, from 13f data we find that the mean and median institutional holdings of IPO stocks as at the end of the first calendar quarter immediately following an IPO is lower for cold IPOs than for hot IPOs. In other words, institutional holdings in cold IPOs are lower than what appears to be the case from pre-flipped allocations.

A tacit arrangement to repurchase the flipped shares should help lead underwriters. In the pre-issue period, they can place the cold IPO shares with other clients by presenting an inflated demand for the offer. A cold IPO is made to look more attractive than it might otherwise allowing the underwriter to pre-sell a weak IPO rather than having to withdraw it.[12] There is evidence that analysts hyped unattractive stocks to bolster investment-banking business. The use of unrealistically rosy analysts' estimates may not have been the only measure used by the industry to hype demand for unattractive offers.

Appendix A

Table A.1 presents the regression results for the 4 regression models of section 4.3, models A, B, C and D, in three different panels using the HS 2-way measure, the HS 3-way measure, and the MRR measure of asymmetric information. The test statistics at the bottom of each panel tests for the equality of the asymmetric information component of large seller-initiated trades for cold IPOs with other large seller-initiated trades against the null hypothesis that the asymmetric information component of large seller-initiated trades for cold IPOs is less than that of other large seller-initiated trades.

[12] Dunbar (2000) shows that withdrawals of IPOs have a detrimental affect on the market share of lead underwriters, which may explain their reluctance to withdraw the IPO.

Table A.1
Asymmetric information regression results using other measures

This table reports the cross-sectional regression results of the various measures of asymmetric information on explanatory variables. The explanatory variables include average daily volume (*VOLUME*); share turnover (*TURNOVER*); the standard deviation of returns (*VOLATILITY*); and indicator variables for the listing exchange. For each asymmetric information measure, four models are estimated:

Model A: IPO sample from IPO period;
Model B: IPO sample from IPO period and post-IPO period;
Model C: IPO sample and matched sample from IPO period; and,
Model D: IPO sample and matched sample from IPO period and post-IPO period.
The regression specification is:

$$\begin{aligned}AI_i^j = {} & \beta_0 + \beta_1\text{VOLUME}_i + \beta_2\text{TURNOVER}_i + \beta_3\text{VOLATILITY}_i \\ & + \beta_4\text{NASDAQ}_i + \beta_5\text{AMEX}_i \\ & + LS_i * \begin{pmatrix}\beta_6 HOT_i + \beta_7 WITHIN_i + \beta_8 COLD_i \\ +\beta_9 CONTROL1_i + \beta_{10} CONTROL2_i + \beta_{11} CONTROL3_i\end{pmatrix} \\ & + LB_i * \begin{pmatrix}\beta_{12} HOT_i + \beta_{13} WITHIN_i + \beta_{14} COLD_i \\ +\beta_{15} CONTROL1_i + \beta_{16} CONTROL2_i + \beta_{17} CONTROL3_i\end{pmatrix} \\ & + M_i * \begin{pmatrix}\beta_{18} HOT_i + \beta_{19} WITHIN_i + \beta_{20} COLD_i \\ +\beta_{21} CONTROL1_i + \beta_{22} CONTROL2_i + \beta_{23} CONTROL3_i\end{pmatrix} \\ & + \varepsilon_i,\end{aligned}$$

where AI_i^j is either the log of the average quoted bid-ask spread; the average asymmetric information component of bid-ask spread using the HS 2-way model; the HS 3-way model; or the MRR model for firm i, LS_i, LB_i, and M_i are indicator variables that take the value 1 for large seller-initiated trades, large buyer-initiated trades and medium sized trades respectively for firm i. Large sells in the IPO stabilization period can belong to hot IPOs (*HOT*), within-range IPOs (*WITHIN*) or cold IPOs (*COLD*). Large sells of the control samples are either large sells of the same IPO firms during the 20-day period one year after the IPO (*CONTROL*1); large sells of a risk matched non-issuing firms during the IPO stabilization period of the issuer (*CONTROL*2); or large sells of a risk matched non-issuing firms during the post-stabilization period of the issuer (*CONTROL*3). None of *CONTROL*1, *CONTROL*2, or *CONTROL*3 appears in Model A, only *CONTROL*1 appears in Model B, only *CONTROL*2 in Model C, and all of *CONTROL*1, *CONTROL*2, or *CONTROL*3 in Model D. The coefficients associated with the different samples are relative to small NYSE trades. The test statistic for the significance of the difference between the coefficients of IPO period large cold IPO sells dummy variable and that of the dummy variables for the other large sells is shown.

	Model A	Model B	Model C	Model D
Panel A. Dependent variable is the asymmetric information component of the bid-ask spread using the Huang and Stoll (1997) 2-way decomposition				
Intercept	0.05	0.05	0.05	0.05
	(33.46)	(47.91)	(50.83)	(70.61)
Volume	−1.89E−08	−1.12E−08	−8.79E−09	−9.00E−09
	(6.71)	(9.05)	(8.24)	(11.25)
Turnover	−1.45E−05	−1.63E−05	−2.31E−05	−1.92E−05
	(1.84)	(1.99)	(2.87)	(2.36)
Volatility	−7.49E−03	−1.72E−02	−2.27E−02	−2.23E−02
	(1.18)	(5.59)	(6.95)	(11.79)
NASDAQ	−1.97E−03	−5.21E−03	−5.24E−03	−6.68E−03
	(1.73)	(5.80)	(6.20)	(10.70)
AMEX	1.35E−02	7.36E−03	1.29E−02	1.39E−02
	(22.84)	(2.04)	(7.10)	(10.56)

Table A.1 (*Continued*)

		Model A	Model B	Model C	Model D
Panel A. Dependent variable is the asymmetric information component of the bid-ask spread using the Huang and Stoll (1997) 2-way decomposition					
Large sell	Hot	0.0031	0.0023	0.0011	0.0018
		(1.64)	(1.23)	(0.59)	(1.01)
	Within	0.0014	0.0009	−0.0003	0.0004
		(0.84)	(0.56)	(0.16)	(0.26)
	Cold	−0.0067	−0.0064	−0.0075	−0.0069
		(3.22)	(3.00)	(3.58)	(3.28)
	Control 1		0.0003		0.0002
			(0.26)		(0.18)
	Control 2			0.0019	0.0020
				(1.28)	(1.42)
	Control 3				−0.0032
					(2.37)
n		1,648	2,946	2,679	5,069
R^2		0.057	0.080	0.107	0.128
Coefficient restrictions					
Large sell hot = large sell cold		15.28***	10.78***	11.07***	10.69***
Within = large sell cold		12.17***	8.72***	9.01***	8.54***
Control 1 = large sell cold			8.61***		9.46***
Control 2 = large sell cold				16.01***	13.60***
Control 1 = Control 3					4.24**
Panel B. Dependent variable is the asymmetric information component of the bid-ask spread using the Huang and Stoll 3-way decomposition					
Intercept		0.008	0.012	0.010	0.013
		(16.29)	(20.89)	(18.87)	(26.06)
Volume		−4.29E−09	−6.09E−09	−1.44E−09	−1.80E−09
		(3.85)	(5.18)	(3.47)	(3.91)
Turnover		−2.19E−07	−1.99E−07	−1.11E−06	−1.49E−06
		(0.11)	(0.07)	(0.37)	(0.42)
Volatility		1.43E−03	−3.23E−03	−1.46E−03	−1.04E−03
		(0.61)	(1.63)	(0.76)	(0.75)
NASDAQ		−4.63E−03	−6.60E−03	−6.41E−03	−8.58E−03
		(11.86)	(14.37)	(13.88)	(20.56)
AMEX		−3.70E−03	−5.74E−03	8.19E−03	5.54E−03
		(2.13)	(2.33)	(5.89)	(4.08)
Large sell	Hot	0.00051	−0.00054	−0.00036	−0.00137
		(0.83)	(0.64)	(0.42)	(1.37)
	Within	0.00031	−0.00110	−0.00073	−0.00186
		(0.55)	(1.44)	(0.92)	(2.08)
	Cold	−0.00067	−0.00179	−0.00135	−0.00225
		(0.93)	(1.79)	(1.31)	(1.87)
	Control 1		0.00315		0.00249
			(4.23)		(2.87)
	Control 2			0.00266	0.00138
				(3.09)	(1.42)
	Control 3				0.00213
					(2.16)

Table A.1 (*Continued*)

		Model A	Model B	Model C	Model D
Panel B. Dependent variable is the asymmetric information component of the bid-ask spread using the Huang and Stoll 3-way decomposition					
n		960	1,412	1,325	2,128
R^2		0.151	0.186	0.220	0.231
Coefficient restrictions					
Large sell hot = large sell cold		1.95	1.07	0.64	0.35
Within = large sell cold		1.48	0.36	0.28	0.07
Control 1 = large sell cold			18.82***		11.65***
Control 2 = large sell cold				10.54***	6.16**
Control 1 = Control 3					0.09
Panel C. Dependent variable is the Madhavan, Richardson and Roomans (1997) measure of the asymmetric information component of the bid-ask spread					
Intercept		0.0265	0.0272	0.0316	0.0294
		(9.37)	(11.95)	(16.87)	(19.23)
Volume		3.27E−09	2.79E−09	7.03E−09	−4.50E−09
		(0.60)	(1.05)	(3.64)	(2.76)
Turnover		−3.49E−05	−3.15E−05	−3.64E−05	−2.93E−05
		(2.28)	(1.80)	(2.49)	(1.77)
Volatility		4.50E−02	−1.38E−02	−2.71E−02	−3.09E−02
		(3.65)	(2.11)	(4.58)	(8.03)
NASDAQ		5.70E−02	6.66E−02	6.18E−02	6.67E−02
		(25.67)	(34.75)	(40.38)	(52.43)
AMEX		1.34E−04	1.62E−03	6.40E−04	2.31E−03
		(0.01)	(0.21)	(0.19)	(0.86)
Large sell	Hot	0.0247	0.0237	0.0275	0.0255
		(6.80)	(5.90)	(8.16)	(6.83)
	Within	0.0004	−0.0017	0.0008	−0.0009
		(0.13)	(0.50)	(0.27)	(0.29)
	Cold	−0.0061	0.0072	−0.0047	−0.0063
		(1.50)	(1.57)	(1.25)	(1.48)
	Control 1		0.0036		0.0063
			(1.28)		(2.48)
	Control 2			0.0007	0.0009
				(0.26)	(0.31)
	Control 3				−0.0044
					(1.61)
n		1,647	2,953	2,679	5,084
R^2		0.355	0.319	0.438	0.404
Coefficient restrictions					
Large sell hot = large sell cold		40.07***	29.65***	46.82***	34.35***
Within = large sell cold		2.10	1.06	1.58	1.14
Control 1 = large sell cold			4.85**		7.20***
Control 2 = large sell cold				1.63	2.18
Control 1 = Control 3					9.93***

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