



Do today's trades affect tomorrow's IPO allocations? ☆

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Abstract

Underwriters using bookbuilding can allocate shares of initial public offerings (IPOs) on the basis of, among other things, commissions paid by investors. In testing the hypothesis that investors trade liquid stocks in order to affect their IPO allocations, we find that money left on the table by IPOs is related to the trading volume of the 50 most liquid stocks near the offer date. For an IPO that leaves \$1 billion on the table, there is abnormal volume of 2.7% to 4.1% in the 50 most liquid stocks over the six days ending on the day that trading commences in that IPO, although only during the internet bubble period is this volume increase statistically significant.

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1. Introduction

Underwriters have discretion in allocating shares of initial public offerings (IPOs) when bookbuilding is used. There are three main theories describing the allocation of shares by investment bankers: (1) the academic view, (2) the pitchbook view, and (3) the

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profit-sharing view. The academic view, expounded by Benveniste and Spindt (1989), argues that IPO allocations are the solution to a mechanism design problem in which regular (i.e., institutional) investors must be given inducements to honestly reveal their private information about the valuation of a firm going public. The pitchbook view, expounded by investment bankers in their presentations to prospective issuing firms, emphasizes that shares will be allocated to buy-and-hold investors, as proxied by institutions that already are large holders of similar firms. The profit-sharing view, expounded by Loughran and Ritter (2002, 2004) and Reuter (2006), argues that hot IPOs are allocated to investors who direct commission business to the investment banking firm in return. This paper tests an implication of the profit-sharing view of IPO allocations.

From 1993 to 2001, the 3,499 firms going public left more than \$93.5 billion on the table, where the amount of money left on the table is defined as the number of shares offered times the difference between the first-day closing price and the offer price. During the internet bubble period of 1999 and 2000, the 803 IPOs left a total of \$63.5 billion on the table. The average IPO during this period had a first-day return of 65% and left \$79 million on the table. When such large wealth transfers are occurring, it is natural to assume that rent-seeking activity will take place. When IPOs are routinely oversubscribed, and underwriters have discretion in allocating shares, underwriters can boost their profits through a *quid pro quo* arrangement by giving large allocations to investors who are willing to offer benefits to the underwriter.

Consistent with the profit-sharing view, regulatory settlements indicate that investment banks allocate IPOs partly on the basis of the trading commissions generated by institutional investors.¹ For example, the January 22, 2002 Securities and Exchange Commission (SEC) settlement with Credit Suisse First Boston (CSFB) states that CSFB allocated hot IPOs to some clients and in return received commissions of up to 65% of the clients' profits within a few days of the IPO.² The clients kicked back part of their profits by paying unusually high commissions on stock trades that in some cases had no other purpose than to generate commissions. According to the SEC's complaint, CSFB's clients paid as much as \$3.00 per share in commissions for block trades executed by CSFB brokers, although the usual commission for institutional investors at the time was 6¢ per share (Goldstein, Irvine, Kandel, and Wiener, 2006). CSFB paid a fine of \$100 million and settled the case with the SEC (without admitting or denying wrongdoing).

On January 9, 2003, the former Robertson Stephens securities unit of FleetBoston Financial Corp. settled similar accusations with the SEC and the National Association of Securities Dealers (NASD) and paid a fine of \$28 million. Beginning on November 17,

¹Although we focus on institutional trading, allocations of IPOs to individuals are also based partly on commissions. For example, in September 2005, the policy of Charles Schwab, Inc. as stated on its website was to restrict IPO allocations to clients who either (i) had a \$100,000 balance in their Schwab brokerage account(s) or (ii) had a \$50,000 balance and had made at least 40 trades during the prior 12 months.

²See SEC press release 2002-14 and the SEC complaint against CSFB for allegations on CSFB IPO allocations. In its January 22, 2002 news release (<http://www.nasd.com>), NASD Regulation, Inc. states that "CSFB's IPO profit sharing practice was widespread, occurring between April 1999 and June 2000. The practice affected more than 300 accounts serviced by the firm's Institutional Sales Trading Desk, its Private Client Services (PCS) Group and its PCS Technology Group" and that "... during the last quarter of 1999, over 3,000 trades were done at these excessive commission rates and hundreds of them were executed with a commission rate of \$1 per share or more."

1997, Robertson Stephens used an explicit formula to allocate IPO shares:³ “The Syndicate Department generally allocated shares by using a formula that was weighted over the course of 18 months in favor of those accounts that generated commissions closer in time to the IPO. This formula was used to calculate a customer’s ‘Syndicate Rank’. ...The Syndicate Department also had discretion to allocate some IPO shares independent of the Syndicate Rank on a case-by-case basis.”⁴

Robertson Stephens Inc. and CSFB are apparently not the only investment banks that allocated IPOs on the basis of commission business. Reuter (2006) reports that for IPOs underwritten by different investment banks from 1996 to 1999, a fund manager’s holdings of an IPO shortly after the offering is positively related to its commission payments to the lead underwriter of the IPO.

Goldstein, Irvine, Kandel, and Wiener (2006) posit that “...commissions constitute a convenient way of charging...for...timely access to information, priority handling of difficult trades and higher allocations of IPO shares.” SEC Commissioner Paul Atkins has publicly stated that it is permissible for IPO allocations to be based on customer “relationships.”⁵ If the linkage between allocations of underpriced IPOs and commission business is too direct, however, then it is a violation of certain securities laws and regulations and self-regulatory organization rules such as NASD Rule 2330. This rule prohibits an NASD member firm from sharing, directly or indirectly, in the profits or losses in any account of a customer.

To date, the finance literature has not addressed the economic consequences of allocating IPOs in return for commission business. To the degree that some of the money left on the table flowed back to underwriters through either implicit or explicit profit-sharing arrangements, this would suggest that the structure of the underwriting industry allowed (i) some underwriters to achieve total compensation that exceeded competitive levels and/or (ii) issuers and their executives to receive additional benefits, such as optimistic analyst coverage of their stock and favorable allocations of hot IPOs into personal brokerage accounts.

Although there is widespread agreement among practitioners that IPOs have been allocated at least partly on the basis of commission business, it is unclear whether this was based primarily on commissions paid over a long period of time or over a short period in close proximity to specific IPOs.⁶ Furthermore, commission revenue is the product of shares traded and the commission per share, and the impact of IPO-related trading on volume has not been documented. Reuter (2006) finds that there is a positive relation between the commissions paid to a given lead underwriter over a long period of time and a mutual fund’s holdings of recent IPOs from that underwriter. Our paper examines the effect of money left on the table by IPOs on the trading volume of the most liquid stocks in the days surrounding the offer date. Thus, we are testing the joint hypothesis that

³See Michael Siconolfi and Anita Raghavan, “Robertson Stephens Tries to Stop ‘Spinning’ of Hot IPOs,” *Wall Street Journal* November 18, 1997.

⁴The quotation is from page 5 of the Acceptance, Waiver and Consent (AWC) No. CAF030001 submitted to the NASD by Robertson Stephens. See press release 2003-3, the SEC complaint against Robertson Stephens, and the AWC for details on the Robertson Stephens case.

⁵Mathewson J. (2004), “U.S. SEC proposes new initial public offering rules,” *Bloomberg News* (October 13, 2004).

⁶See, e.g., Lucchetti, A. (1999), “SEC probes rates funds pay for commissions,” *Wall Street Journal* (September 16, 1999, p. C1).

(i) money left on the table in IPOs affects commission revenue, (ii) some of the higher commission revenue occurs through higher volume, and (iii) there is a short-run effect on volume.

Bookbuilding, also known as a firm commitment contract, has been the dominant method for selling IPOs in the U.S. for many years. All IPO allocation data are confidential in the U.S., although there have been several academic studies utilizing such data (e.g., Aggarwal, 2000; Boehmer, Boehmer, and Fishe, 2006; Hanley and Wilhelm, 1995). The biggest obstacle for any research on this topic is the availability of detailed IPO allocation and commission data.

In this study, we use an innovative empirical design to solve this data availability issue. In the profit-sharing view of IPO allocations, an investor that generates more commission revenue will receive a large allocation of a hot IPO. To boost its commission ranking, an investor could engage in stock churning, defined for the purposes of this paper as trading with commission generation as the only intent. Other trading that an investor could engage in to generate commissions is more subtle. For example, an investor could engage in portfolio rebalancing and time the trading to occur around IPO dates. An investor could also undertake routine trading that is not time-sensitive around IPO dates. For expositional convenience, we use the term “IPO-related trading” for all trading with a whole or partial purpose of generating commissions to affect IPO allocations.

If the purpose of IPO-related trading is to generate commissions that transfer profits from IPO recipients back to the investment banking firm, there is an incentive to structure the trades in a manner that minimizes the “leakage” to other market participants. Leakage can be reduced by decreasing trading costs due to bid-ask spreads and price impact. A variety of trading strategies could be employed to minimize this leakage. One mechanism would be to simultaneously submit buy and sell orders for the identical block of stock with two different securities firms. For almost all conceivable strategies, trading highly liquid stocks would be preferred, in order to minimize bid-ask spreads and price impact costs, and to avoid the attention that would come from trading a large block of a less liquid stock.

To capture IPO-related trading, we use the trading volume of the 50 most actively traded stocks. We choose the top 50 stocks for each trading day based on the rank of a stock’s average trading volume for the past 20 trading days, after excluding stocks with high volatility or a price below five dollars. For the 3,499 IPOs during our sample period from 1993 to 2001, we aggregate the money left on the table by IPOs by offer dates, and obtain a time series of the daily amount of money left on the table. With controls for market movements, a time trend, and calendar-related patterns in trading volume, we employ an autoregressive model with four lags to study the relation between the daily trading volume of the 50 most liquid stocks and the amount of money left on the table by IPOs. If short-run commission generation is an important factor in IPO allocation, there should be a positive relation between the amount of money left on the table and the trading volume of liquid stocks around the IPO dates.

Because of changes in IPO practices, we partition our sample period into three subperiods: the pre-internet bubble period (1993–1998), the internet bubble period (1999–2000), and the post-internet bubble period (2001). For all three subperiods, each \$1 billion left on the table during the six trading days beginning on day t generates abnormal volume in the 50 most liquid stocks of between 2.7% and 4.1% on day t .

The average amount of money left on the table during a six-day window for the three subperiods is, respectively, \$107 million, \$756 million, and \$72 million. Our point estimates thus imply that IPO-related trading increases turnover in the 50 most actively traded stocks by a statistically insignificant 0.4% during 1993–1998, a statistically significant 2.0% during 1999–2000, and a statistically insignificant 0.2% during 2001. Since the 50 most actively traded stocks account for approximately 25% of aggregate market volume, if other stocks were not affected by IPO-related trading, these numbers suggest that even during the bubble years aggregate volume was boosted only 0.5% by IPO-related trading. This calculation suggests that the effect of IPO-related trading on aggregate trading volume is economically insignificant in normal market conditions, but statistically significant yet modest during the bubble years. This is the central finding of our paper.

The commissions generated from the increase in trading volume during the bubble period are economically important. The extra trading volume of 2%/day for the liquid stocks would result in an additional \$656,000/day in commissions if we assume an average commission of 10¢ per share.⁷ This \$656,000/day in commissions, however, represents only 0.52% of the \$126 million per day left on the table during the bubble period, a much lower payback ratio than the 30% or even 65% kickbacks revealed in the CSFB regulatory case.

There are several reasons to believe that our estimate of the share of profits flowing back to underwriters is biased downwards. Higher commissions can be generated either by trading more shares or through higher commissions per trade. We only capture commissions generated by higher trading volume. In order to generate commissions at a given underwriter, investors can simply direct trading to this underwriter rather than to another entity such as an electronic communication network (ECN) or crossing network, with no incremental trading occurring. Investors can also trade less liquid stocks, but submit buy and sell orders simultaneously with different brokers to mitigate the market impact. Most importantly, we only measure the short-run trading volume that is induced by rent-seeking investors in pursuit of IPO allocations.

Our findings complement those of Reuter (2006). Our empirical evidence suggests that there is not only a relation between long-term commission business and IPO allocations (Reuter's finding), but also a short-run relation during the bubble period between the aggregate amount of money left on the table and aggregate trading volume.

2. Data, the metric for IPO-related trading, and summary statistics

2.1. Data

We use the Securities Data Company's (SDC) new issues database to identify IPOs from 1993 to 2001. All unit offerings, American Depositary Receipts (ADRs), Real Estate Investment Trusts (REITs), and closed-end funds are excluded. We also exclude banks and savings and loans (SIC 6020–6120 and 6712) and all IPOs with an offer price of less than \$5. We also exclude all IPOs that are not included in the Center for Research in Security Prices (CRSP) database.⁸

⁷The average commission rate of 10¢ is based on a weighted average of 6¢ per share paid by mutual funds and 50¢ or more paid on some trades by hedge funds. Mutual funds received a much larger proportion of IPO allocations than hedge funds did during our sample period.

⁸We use the CRSP database to check the IPO offer date and first-day closing price. The IPO offer dates reported in the SDC database are often one day earlier than the actual first trading date (the pricing date usually is the day before the actual trading date but after the market close). We use the date when the IPO first appears in

The transaction data used to calculate trading volume for all stocks come from the New York Stock Exchange's Trades and Quotes (TAQ) database. For each stock, transactions executed after the market close and/or on regional exchanges are excluded because the liquidity conditions are usually worse in aftermarket trading and on regional exchanges.

2.2. The metric for capturing IPO-related trading

We use the trading volume of the top 50 liquid stocks to capture IPO-related trading. This metric is constructed as follows. First, for each trading day, we rank all stocks based on the average of the past 20 trading days' intraday quote-to-quote return standard deviation. Second, we exclude stocks with a price below \$5 or with a volatility rank higher than 2,500, where the stock with the lowest volatility has a rank of one. These screens eliminate roughly two-thirds of CRSP-listed stocks on any given day. Stocks with a low price or high volatility are unlikely to be good candidates for IPO-related trading because of their high risk and limits on commissions per share paid on low-priced stocks. Third, we calculate the share volume for each remaining stock, during which transactions executed after the market close or on regional exchanges are excluded. For stocks listed on NASDAQ, we divide the volume by two to reflect the different conventions of reporting volume on NASDAQ versus the American and New York Stock Exchanges. We then calculate the mean and standard deviation of the daily volume for the past 20 trading days for each stock.

For any trading day, if the difference between a stock's current trading volume and the past 20 days' average is more than four times greater than its past 20-day standard deviation of volume, the stock is excluded. This excludes about 3% of the sample. The reason for doing so is because IPO-related trading is unlikely to increase a liquid stock's daily volume by this magnitude. Some events, such as stock splits or significant news, can cause dramatic increases in daily trading volumes. To minimize the noise in our metric, we exclude those stocks for those specific days.

Finally, for each trading day (day t), all remaining stocks are ranked based on the past 20-days' average daily volume to identify the 50 stocks with the highest volume. We use past volumes, instead of current volumes, to rank stocks to avoid any potential look-ahead bias. The total trading volume of these 50 ranked stocks, denoted as TVOL50, is then used as the metric to capture IPO-related trading on day t .

Although IPO-related trading is more likely to be associated with large liquid stocks, our choice of the top 50 stocks is somewhat arbitrary. It is plausible that stocks ranked among the top 200 or 500 could also be good candidates, especially when fund managers merely try to time trades motivated by portfolio rebalancing to occur around IPO dates. Each top stock ranked by trading volume would capture the IPO-related trading with a positive probability. But it is plausible that the higher the rank, the higher is the probability. Meanwhile, stock trading volumes are very volatile, and the daily volume of any given stock has a lot of noise. So, if we view the IPO-related trading as a signal we want to capture, we need to include a certain number of stocks in our measure in order to increase the signal-to-noise ratio. The addition of each stock along the rank of trading volume

(footnote continued)

the CRSP database as the offer date when there is only a one-day difference between the SDC database and the CRSP database. When the difference is more than one day apart, the New York Stock Exchange's Trade and Quote (TAQ) database and Yahoo! are used to verify the dates.

Table 1

Summary daily statistics for trading volumes

This table reports daily statistics for trading volumes for all CRSP-listed (Amex, NASDAQ, and NYSE) stocks and the top 50 stocks based on lagged trading volume, TVOL50, the metric used to capture IPO-related stock trading. The sample period is from 1993 to 2001. The TAQ database is used to calculate the daily trading volume of each stock. We exclude transactions executed on regional exchanges and/or after the market close. For stocks listed on NASDAQ, we divide the volume by two. We report the statistics separately for three subperiods.

	Mean daily volume/stock (in 1000s)	Mean total daily volume (in 1000s)	Minimum total daily volume (in 1000s)	Maximum total daily volume (in 1000s)	Std. dev. of total daily volume (in 1000s)	Mean number of stocks/day
<i>Panel A: 1993–1998</i>						
All Stocks	81	615,246	125,019	1,698,260	242,698	7,390
TVOL50	2,032	101,579	17,773	341,661	50,574	50
<i>Panel B: 1999–2000</i>						
All Stocks	193	1,495,511	626,049	2,763,978	361,702	7,745
TVOL50	6,435	321,766	103,713	758,875	109,067	50
<i>Panel C: 2001</i>						
All Stocks	280	1,992,530	659,668	3,290,132	394,134	7,126
TVOL50	10,628	531,393	160,954	930,199	122,167	50

would potentially capture more of the IPO-related trading, but at a decreasing rate. There are no clear rules that allow us to determine the maximum signal-to-noise ratio. We use TVOL50 to try to achieve the close-to-optimum signal-to-noise ratio.⁹

2.3. Summary statistics

We partition our sample period into three subperiods: the pre-internet bubble period (1993–1998), the internet bubble period (1999–2000), and the post-internet bubble period (2001). We report the summary statistics of daily trading volumes of all stocks and the 50 most liquid stocks in Table 1. For the three subperiods, the number of stocks traded per day does not change much –7,390 stocks for the pre-internet bubble period, 7,745 stocks for the internet bubble period, and 7,126 stocks for the post-internet bubble period. However, trading volume has increased dramatically, partly due to stock splits and partly due to higher turnover. For example, the mean daily total trading volumes of all stocks for the three subperiods are, respectively, 615, 1,496, and 1,993 million shares (after dividing NASDAQ volume by two). For the top 50 stocks (TVOL50), the mean daily total trading volumes are 102, 322, and 531 million shares, respectively. The standard deviation of total daily trading volume has also increased over time, although by a lower percentage than the mean has increased. Note that the top 50 stocks are selected based on the past twenty days' trading volume, and they do not necessarily capture the most heavily traded 50 stocks of the current day.

The summary statistics for IPOs are reported in Table 2. We have 3,499 IPOs in the nine-year sample period, of which 2,620 went public during the pre-internet bubble period,

⁹To make sure better metrics are not excluded, we also repeated our analysis using the top 30 stocks, or ranking stocks based on both volume and the bid-ask spread. The results (not reported) are similar but slightly weaker.

803 went public during the internet bubble period, and only 76 went public during 2001. The summary statistics for the whole sample and for the different subperiods that are reported in Panel A of Table 2 are consistent with what has been reported in the literature. We also report the daily summary statistics of our IPO sample in Panel B of Table 2. Except for the post-internet bubble period, there are on average more than 1.5 IPOs per day, and there are IPOs on more than half of the trading days. There is extreme variation in IPO activity from day to day. For example, during the internet bubble period, the standard deviation of the amount of money left on the table is \$285 million per day, while the mean is only \$126 million per day. Note that these measures of the money left on the table exclude the effect of overallotment options, and the number of shares offered is measured as the domestic tranche only. Thus, our estimates of the money left on the table are conservative.

Another noticeable feature about IPOs is the day-of-the-week pattern, as shown in Fig. 1. The lead underwriter and the issuing firm usually finalize the offer price and allocate shares to investors the day before trading starts. To avoid weekend uncertainties, IPOs rarely start to trade on Mondays. For the other four weekdays, slightly more firms start trading on Thursday and Friday. The first-day returns also demonstrate a day-of-the-week pattern, with mean first-day returns rising from Tuesday through Friday.¹⁰

3. The effect of money left on the table on trading volume

3.1. The model

The summary statistics in Table 1 indicate that trading volume is very volatile, and the metric that we use to capture IPO-related trading is fairly noisy. During the internet bubble period, for example, the coefficient of variation (standard deviation divided by the mean) of total daily trading volume for the top 50 stocks is 34%. Therefore, it is important to control for the impact on trading volume of factors that are unrelated to IPO activity. The literature on trading volume has focused on the contemporaneous relations between volume and price movements (see, e.g., Karpoff, 1987; Campbell, Grossman, and Wang, 1992; He and Wang, 1995; Andersen, 1996; Llorente, Michaely, Saar, and Wang, 2002). To control for the time trend in volume, we use *Date_Index* as an explanatory variable in our regressions, where *Date_Index* is the sequential number of each trading day (t for day t) divided by 2,268, the total number of trading days in our sample period. (For the rest of this paper, the value of a variable is measured on day t unless stated otherwise.) The time series of trading volumes used in this paper is a stationary process after de-trending, which is consistent with the literature (e.g., Andersen, 1996; Llorente, Michaely, Saar, and Wang, 2002).

The time series of TVOL50 also demonstrates a correlation with general market conditions in addition to the time trend. We use the nominal level of the S&P 500 (SP500) index to control for this relation. The literature and the analysis of our data also suggest that trading volumes demonstrate calendar-related patterns. IPO activity, as indicated in Fig. 1, also shows day-of-the-week patterns. We use four weekday dummies (Tuesday

¹⁰The first-day returns on Mondays are dominated by a few outliers because of the small number of IPOs that go public on Monday. The lower first-day returns on Tuesdays and Wednesdays relative to Fridays are probably due to a tendency to delay deals on which there is buyer resistance from the latter part of the previous week until Tuesday or Wednesday of the following week.

Table 2

Summary statistics on IPOs

This table reports summary statistics for the IPO sample for the sample period from 1993 to 2001 and for three subperiods. Panel A reports descriptive statistics of the IPO sample, and Panel B reports daily statistics. The first-day return is defined as the return from the offer price to the first-day close price. Money left on the table is defined as the difference between the offer price and the first-day close price multiplied by the number of shares offered (domestic tranche only), assuming no exercise of overallocation options. Both the proceeds and the money left on the table are adjusted using the CPI to year 2000 dollars (year 2001 is not adjusted). In Panel B, all daily statistics are unconditional, except for the amount of money left on the table in the last row, which conditions on at least one IPO on that day.

	1993–2001	1993–1998	1999–2000	2001
<i>Panel A: IPO means</i>				
Number of IPOs	3,499	2,620	803	76
Mean number of shares offered (000s)	5,282	3,869	7,981	25,459
Mean proceeds (\$ millions)	99.18	71.73	155.80	446.92
Mean first-day return (%)	27.11	15.87	64.96	14.44
Mean money left on the table (\$ millions)	26.73	10.33	79.04	39.04
<i>Panel B: Daily statistics</i>				
Number of trading days	2,268	1,516	504	248
Number of days with IPOs	1,288	953	278	57
Mean number of IPOs per day	1.54	1.73	1.59	0.31
Mean number of IPOs with positive first-day returns per day	1.21	1.34	1.31	0.25
Mean daily money left on the table (\$ millions)	41.23	17.86	125.93	11.97
Standard deviation of daily money left on the table (\$ millions)	146.95	43.20	284.86	51.49
Minimum daily money left on the table (\$ millions)	–276.52	–7.67	–276.52	–36.11
Maximum daily money left on the table (\$ millions)	2,608.72	518.49	2,608.72	616.31
Mean daily money left on the table conditioning on at least 1 IPO (\$ millions)	72.60	28.41	228.30	52.06

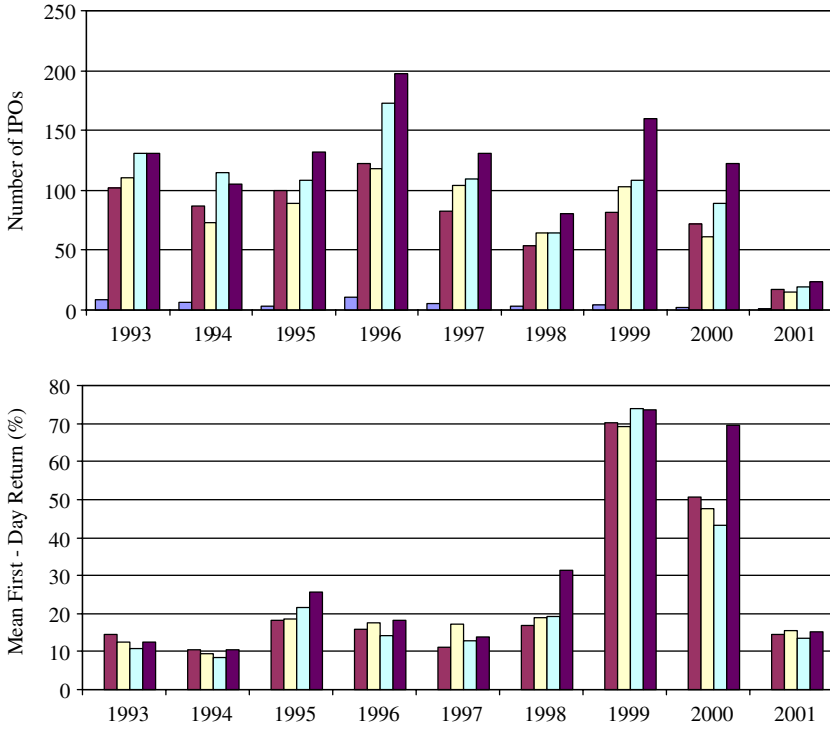


Fig. 1. Day-of-the-week pattern of IPOs. This figure demonstrates the existence of a day-of-the-week pattern in both the number of deals and the average first-day return for IPOs. We group IPOs by year. Figs. 1A and 1B report the number of IPOs and the mean first-day return on different weekdays, respectively. For each year in each figure, one bar represents one weekday from Monday through Friday from left to right. Over the sample period, the mean first-day return and the number of IPOs on each weekday are as follows: 35.87% and 44 (Monday), 24.57% and 719 (Tuesday), 25.83% and 737 (Wednesday), 23.93% and 916 (Thursday), and 31.99% and 1,083 (Friday). Because of relatively few IPOs on Monday, the mean first-day return of Monday is sensitive to outliers (for example, there are only two IPOs on Monday for year 2000, and the average first-day return is 258%). For expositional purposes, the first-day return on Monday is set as zero in Fig. 1B.

through Friday) and 11 month dummies (January through November) as controls for calendar-related patterns.

The volume literature suggests a strong relation between trading volume and price volatility (Jones, Kaul, and Lipson, 1994). IPOs on the first day also have asymmetric betas in up and down markets (Chan and Lakonishok, 1992). We use the S&P 500 index return and its absolute value, R_m and $|R_m|$, to control for marketwide price movements. In sum, we use the following autoregressive model:

$$\begin{aligned}
 Volume = & \alpha + \eta_1 Date_Index + \eta_2 SP500 + \sum_{i=1}^4 \lambda_i Weekday_i \\
 & + \sum_{i=1}^{11} m_i Month_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i Volume_{-i} \\
 & + \gamma Money + \varepsilon.
 \end{aligned}
 \tag{1}$$

In the model, the dependent variable, *Volume*, is the natural log of TVOL50 for day t multiplied by 100. This enables us to interpret any change of *Volume* in percentage terms. Four lagged variables of *Volume* are used to remove the autoregressive part of the TVOL50 metric. This is the same approach that Naranjo and Nimalendran (2000) use to measure the unexpected trading volume in the U.S. Dollar–German Deutsche Mark foreign exchange market. The variable *Money*, measured in hundreds of millions of year 2000 dollars (year 2001 is unadjusted), is used to capture the money left on the table by IPOs in a window around day t . We employ two different measures for the amount of money left on the table. We first use the daily amount of money left on the table by IPOs for the day before the current day ($Money_{-1}$), the current day ($Money_0$), and the next nine days ($Money_{+1}$ through $Money_{+9}$). The second measure we use is the aggregate amount of money left on the table for various window lengths around day t . If our hypothesis is correct, we would expect the coefficients on *Money* to be positive.

The important goal for the use of variables measuring daily money left on the table is to gauge the timing of the impact of IPO activity on volume. We include one lagged money left on the table variable for the daily IPO activity measure. Regulatory investigations of CSFB indicate that commission payments from hedge funds peaked within a narrow window relative to when some hot IPOs started trading, reflecting explicit profit-sharing agreements.¹¹ We include the money left on the table on day $t - 1$ to test whether it was common practice for there to be ex post profit-sharing after the IPO. The use of money on the table on day $t + 1$ to day $t + 9$ is based on the assumption that institutional investors are able to forecast which IPOs will be hot deals several days in advance, and that IPO allocations are affected by commissions generated in the days immediately prior to the IPO. The “partial adjustment” literature as well as discussions with industry participants suggests that this is a reasonable assumption.

In unreported results, we have analyzed the ability of forecasts of first-day returns made in an industry newsletter (*The IPO Reporter*, 1998–2000) to predict realized first-day returns on IPOs from 1998 to 2000. Each week, this newsletter assigns an “opening consensus premium” on a scale of 1/4 to 5+ for most IPOs that are scheduled to come to market during the following two to three weeks. Almost all IPOs with first-day returns of 100% or more were given 5 or 5+ ratings several weeks in advance of the offer date (frequently prior to the start of the road show), suggesting that institutional investors were able to predict which IPOs would leave large amounts of money on the table.

3.2. Regression results and analysis

We estimate the regression model specified in Eq. (1) for the three subperiods. The regression results are reported in Table 3. The coefficients for the control variables are consistent with our expectations. The positive coefficients for *Date_Index* during the pre- and internet bubble periods capture the increase in trading volume over time. *S & P500* also explains part of the variation in trading volume over time. The time variation in

¹¹Page 8 of the NASD Regulation, Inc. Letter of Acceptance, Waiver, and Consent No. CAF020001 with CSFB states “Payment of inflated commissions ostensibly for brokerage services ... involved at least 300 Customer Accounts. During the last quarter of 1999, over 3000 trades were done at these excessive commission rates and hundreds of trades were effected with a commission rate of \$1.00 per share or more. ... Over 90% of the excessive commission transactions executed on the day of, the day before, or the day after a CSFB managed IPO, were done by accounts that were allocated shares by CSFB in that hot IPO.”

Table 3

Regression of trading volume on daily money left on the table by IPOs

This table reports time-series regression results for all IPOs for three subperiods. The model specification is as follows:

$$\begin{aligned}
 Volume = & \alpha + \eta_1 Date_Index + \eta_2 SP500 + \sum_{i=1}^4 \lambda_i Weekday_i \\
 & + \sum_{i=1}^{11} m_i Month_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i Volume_{-i} \\
 & + \sum_{i=-1}^9 \gamma_i Money_i + \varepsilon.
 \end{aligned}$$

In the regression, all variables, unless suggested by the subscripts, are measured on day t , where t is from 1 to 2,268 (the total number of days in our sample period). The dependent variable $Volume$ is the natural log of the daily total volume of the top 50 stocks on the NYSE, Amex, and NASDAQ ranked by lagged volume, multiplied by 100. NASDAQ volume is divided by 2. $Date_Index$ is the sequential number of day t divided by the total number of trading days (2,268). $SP500$ is the level of the S&P 500 index. The weekday dummies, $Weekday_1$ through $Weekday_4$, correspond to Tuesday to Friday. The 11 monthly dummies, $Month_1$ through $Month_{11}$, refer to January to November. The market return on day t , R_m , is the return on the S&P 500 Index, and $|R_m|$ is the absolute value of the market return. The $Money_i$ variable is the summation of the total amount of money left on the table by all IPOs on day $t + i$, where $i = -1, 0, \dots, 9$. The amount of money left on the table is measured as the difference between the first-day close price and the offer price multiplied by the number of shares offered, adjusted to year 2000 dollars (year 2001 is not adjusted). For presentation purposes, the money left on the table is measured in hundred millions (it is measured in millions in the previous table). The significance of the variables measuring money left on the table is indicated using ** (significant at the 5% level) and *** (significant at the 1% level). T -statistics, corrected for heteroskedasticity and autocorrelation (Newey and West, 1987), are in parentheses. We use four lags in correcting the standard errors for possible autocorrelation. The F -statistics for the regressions, which are all significant at the 1% level, are omitted. The number of observations (the number of trading days) for the three subperiods are, respectively, 1,516, 504, and 248.

Variable	1993–1998	1999–2000	2001
Intercept	791.78 (13.20)	976.34 (7.99)	1,789.51 (4.09)
<i>Date_Index</i>	55.20 (7.54)	311.33 (7.68)	-106.34 (-0.32)
<i>S & P500</i>	0.03 (5.41)	-0.06 (-2.70)	-0.08 (-1.76)
<i>Tuesday</i>	15.57 (11.03)	6.62 (2.86)	14.57 (4.62)
<i>Wednesday</i>	17.38 (12.18)	8.00 (3.57)	17.91 (5.01)
<i>Thursday</i>	11.86 (8.22)	4.77 (2.08)	15.63 (6.12)
<i>Friday</i>	6.54 (3.44)	-2.16 (-0.70)	7.16 (1.47)
<i>January</i>	12.57 (4.18)	18.85 (2.90)	6.11 (0.20)
<i>February</i>	9.83 (3.31)	6.39 (1.27)	-0.11 (-0.00)
<i>March</i>	9.06 (3.14)	11.46 (2.07)	0.76 (0.03)
<i>April</i>	9.39 (3.21)	16.08 (2.66)	1.36 (0.06)

Table 3 (continued)

Variable	1993–1998	1999–2000	2001
<i>May</i>	5.14 (1.78)	1.65 (0.28)	-8.96 (-0.45)
<i>June</i>	3.17 (1.13)	2.00 (0.33)	-11.47 (-0.70)
<i>July</i>	5.02 (1.62)	0.75 (0.12)	-20.37 (-1.65)
<i>August</i>	3.68 (1.27)	-3.51 (-0.57)	-28.23 (-2.65)
<i>September</i>	5.79 (1.96)	0.89 (0.16)	-4.56 (-0.48)
<i>October</i>	8.52 (2.84)	6.05 (1.34)	-8.94 (-1.22)
<i>November</i>	3.59 (1.02)	1.38 (0.27)	-8.11 (-1.16)
R_m	-0.78 (-1.80)	-0.57 (-1.32)	1.02 (1.68)
$ R_m $	8.68 (10.20)	4.40 (6.03)	4.95 (4.49)
$Volume_{-1}$	0.41 (10.87)	0.34 (6.62)	0.34 (5.06)
$Volume_{-2}$	0.08 (2.96)	0.08 (1.79)	-0.10 (-1.28)
$Volume_{-3}$	0.03 (1.21)	0.01 (0.22)	-0.06 (-0.74)
$Volume_{-4}$	0.01 (0.59)	-0.02 (-0.53)	0.02 (0.28)
$Money_{-1}$	-0.74 (-0.76)	-0.12 (-0.57)	1.88 (1.00)
$Money_0$	0.02 (0.02)	0.70*** (3.50)	-1.12 (-0.87)
$Money_{+1}$	-0.31 (-0.38)	0.45*** (2.98)	0.68 (0.57)
$Money_{+2}$	2.30*** (2.79)	-0.04 (-0.24)	-0.61 (-0.33)
$Money_{+3}$	-0.22 (-0.28)	0.29 (1.51)	0.56 (0.41)
$Money_{+4}$	1.48 (1.50)	0.02 (0.10)	-1.88 (-1.41)
$Money_{+5}$	-0.87 (-0.72)	0.41** (2.27)	-1.69 (-0.85)
$Money_{+6}$	-0.11 (-0.14)	-0.13 (-0.68)	-0.62 (-0.55)
$Money_{+7}$	1.29 (1.27)	-0.02 (-0.13)	-0.66 (-0.52)
$Money_{+8}$	1.00 (1.18)	0.04 (0.23)	-0.80 (-0.61)
$Money_{+9}$	-1.51 (-1.13)	-0.22 (-1.09)	1.01 (0.64)

volume in 2001 is captured by *Date_Index*, *S* & *P500* and the 11 month dummies. Volume also increases when the market is volatile, and this is captured by the significant coefficient for $|R_m|$ in all three subperiods. For example, the coefficients on R_m and $|R_m|$ for the pre-internet bubble period imply that a 1% daily market return is associated with a 7.9% increase in volume relative to volume in a flat market. The coefficient on R_m is negative during the pre- and internet bubble periods, reflecting the asymmetric relation between volume and price movements in up and down markets. The first two lags of the volume variable account for the autocorrelation in trading volume, consistent with our expectations.

The money left on the table on the day before the current day (day $t - 1$) has no significant impact on the current-day volume (day t volume) in any of the three subperiods. This result indicates that explicit profit-sharing arrangements with ex post settling up allegedly used by some members of the CSFB sales force were not a widespread practice. The variables measuring money left on the table for the rest of the ten days from t to $t + 9$ display significantly positive coefficients for some days during the pre- and the internet bubble periods. For the pre-internet bubble period, only the coefficient for $Money_{+2}$ is significant. For the internet bubble period, the coefficients for $Money_0$, $Money_{+1}$, and $Money_{+5}$ are statistically significant at the 1% or 5% levels. For no subperiods are any of the $Money_{+6}$ to $Money_{+9}$ coefficients significantly different from zero. This suggests that money left on the table is associated with higher abnormal trading volume during a six-day period prior to the IPO offer date, consistent with the profit-sharing hypothesis. However, we find little support for the profit-sharing hypothesis for the post-internet bubble period—none of the coefficients during this period are significant. It should be noted that the regulatory scrutiny of IPO allocation practices was first publicized in December 2000, so it is indeed possible that a structural shift occurred. The coefficients for the variables measuring money left on the table during the internet bubble period suggest that IPOs affect the trading volume on and before the offer dates, but there is no evidence of ex post setting up.

Rather than focusing on each day separately, in Table 4 we aggregate the money left on the table by IPOs for a rolling window of three different lengths: $[t, t + 2]$, $[t, t + 5]$, and $[t, t + 9]$. We re-estimate the regression model in Eq. (1) by replacing the daily money variables with the aggregated variable. The coefficients for the control variables in Table 4 are similar to those in Table 3, and are not reported. The coefficients for the variables measuring aggregated money left on the table with different aggregation windows are positive for all three subperiods. They are only statistically significant for the internet bubble period, however. For this subperiod, all three aggregated variables are significant at the 1% level. It should be noted that the point estimates are similar for all three subperiods in Table 4, but the standard errors are smaller in the internet bubble period because there is much more variation in the explanatory variable as shown in Panel B of Table 2, allowing more precise parameter estimates.

Besides statistical significance, the coefficients for the variables measuring money left on the table also suggest that IPO-related trading captured by liquid stocks is economically important during the internet bubble period. To assess the economic importance, we assume that new issues appear with equal frequency and all days are average days, and we use a six-day aggregation window. Based on the numbers reported in Table 2, we would have \$126 million (the mean daily amount of money left on the table) \times 6 (the number of days in the window period) = \$756 million left on the table for an arbitrarily chosen

Table 4

Regression of trading volume on aggregate money left on the table by IPOs

This table reports time-series regression results for all IPOs for three subperiods. The model specification is as follows:

$$\begin{aligned}
 \text{Volume} = & \alpha + \eta_1 \text{Date_Index} + \eta_2 \text{SP500} + \sum_{i=1}^4 \lambda_i \text{Weekday}_i \\
 & + \sum_{i=1}^{11} m_i \text{Month}_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i \text{Volume}_{-i} \\
 & + \gamma \text{Aggregate_Money}[i, j] + \varepsilon.
 \end{aligned}$$

In the regression, the dependent variable, *Volume*, is the natural log of the daily total volume of the top 50 stocks on the NYSE, Amex, and NASDAQ ranked by lagged volume, multiplied by 100 (the same as in Table 3). All the control variables are also the same as those in Table 3. For the measure of money left on the table, we use the aggregated amount of money left on the table (measured in units of \$100 million) from day $t + i$ to day $t + j$. Three different aggregation windows around day t (i.e., $i = 0$) are used. *Aggregate_Money*[0, 2] is the aggregate amount of money left on the table by IPOs over a window of $[t, t + 2]$, for example. The other two measures are similarly denoted. The coefficients for all the control variables are similar to the ones reported in Table 3 and are omitted. The significance of the variables measuring aggregate money left on the table is indicated using *** (significant at the 1% level). *T*-statistics, corrected for heteroskedasticity and autocorrelation (Newey and West, 1987), are in parentheses. We use four lags in correcting the standard errors for possible autocorrelation. The *F*-statistics for the regressions, which are all significant at the 1% level, are omitted. The number of observations (the number of trading days) for the three subperiods are, respectively, 1,516, 504, and 248.

Variable	1993–1998	1999–2000	2001
<i>Aggregate_Money</i> [0, 2] _{<i>t</i>}	0.72 (1.41)	0.41*** (3.64)	0.76 (0.60)
<i>Aggregate_Money</i> [0, 5] _{<i>t</i>}	0.41 (1.32)	0.27*** (3.99)	0.29 (0.30)
<i>Aggregate_Money</i> [0, 9] _{<i>t</i>}	0.29 (1.17)	0.14*** (3.25)	0.43 (0.50)

six-day window during the internet bubble period. This indicates that IPO-related trading could cause a $0.27 \times 756/100 = 2.04\%$ increase in the trading volume on day t , where we divide by 100 because in the regressions the money left on the table is measured in hundreds of millions.

For the other two subperiods, our Table 4 point estimates imply that money left on the table by IPOs during a six-day window increased turnover in the 50 most actively traded stocks by a statistically insignificant 0.4% (mean daily money left on the table from Table 2 of \$18 million/ 100×6 days $\times 0.41$) during 1993–1998 and 0.2% (\$12 million per day / 100×6 days $\times 0.29$) during 2001.

On an average trading day during 1999–2000, the 2.04% increase in volume attributable to rent-seeking activity would translate into 6.56 million shares and \$656,000 additional commissions if the average commission per share is 10¢. For the three-day and the ten-day windows, the incremental trading commissions on a 10¢ per share basis would be \$499,000 and \$566,000, respectively. This is consistent with the regression results with variables

measuring daily money left on the table. The ten-day window of $[t, t+9]$ includes days beyond day $t+5$ for which money left on the table in the future does not have much impact on the current-day trading. This suggests that investors try to act during the week (five trading days) in anticipation of a hot IPO, and that the six-day window better captures the impact of the money left on the table on current-day trading volume.

The above estimates are conservative. Our metric does not capture all IPO-related trading, and the aggregated amount of money left on the table during a six-day window affects not only the current-day trading volume, but also the volume over a longer time period when rent-seeking behavior is present (Reuter, 2006). But we believe that this is sufficient to show that these numbers are economically not trivial. The regulatory settlements and discussions with practitioners suggest that only hedge funds, which were allocated approximately 7% of the shares in several of the IPOs featured in regulatory settlements, regularly paid high per-share commissions with explicit profit-sharing arrangements. Mutual funds, which are regulated, are not alleged to have paid extremely high per-share commissions.

Our estimate that IPO-related rent-seeking activity during 1999–2000 led to a 2.04% increase in the trading volume of the most liquid stocks is lower than the 10% increase in aggregate trading volume that Ritter and Welch (2002) conjecture. This is partly due to the fact that we purposely stay conservative in our above calculations, and we only measure trading over a short period around the IPO. However, Ritter and Welch could have overestimated the effect of rent-seeking behavior on aggregate trading volume to the degree that trades that would have occurred anyway are merely redirected to integrated securities firms that have hot IPOs to allocate rather than to ECNs or other venues where there are no IPOs to hand out. Furthermore, to the degree that profit sharing was implemented via higher commissions per share rather than via extra trading, there would be a smaller effect on volume.

For the internet bubble period, the 2.04% increase in trading volume per day implies only a 0.52% payback of the \$126 million/day left on the table if we assume an average commission of 10¢/share. This estimate is far lower than the 30% or even 65% payback ratios alleged in the CSFB regulatory settlement. Knowledgeable practitioners have supplied to us “guesstimates” of the payback rate during the internet bubble ranging from a low of 5% to a high of 30%. Our lower payback rate estimate is partly due to the fact that our estimate is biased downwards. Specifically, wash sales and excessive trading of less liquid stocks are not included, and we are only estimating the short-run relation. Our finding suggests that most of the paybacks occurred over a longer time period. In other words, commissions during the past year, instead of just this week’s commissions, affect next week’s IPO allocations.

4. Are the results for the internet bubble period driven by changes in market conditions?

Our regression results show that each \$1 billion left on the table results in 2.7% to 4.1% higher trading volume of the top 50 liquid stocks. However, one could argue that other factors could be driving the coefficients on the money variables in Eq. (1). One alternative hypothesis is that the information environment for the market varies over time. When the overall dispersion of private information (disagreement among investors) is high, trading will be more active. Meanwhile, the increased heterogeneity of opinions would also induce higher IPO underpricing. This would induce a positive coefficient for the money variable.

Alternatively, investment banks and the issuing companies might prefer to time the offering to coincide with a period when trading is active. This would also induce a positive coefficient for the money variable in a regression setup such as that in Eq. (1).

Both alternative hypotheses suggest that we could have an omitted variable problem. That is, besides the lagged volumes on the right-hand side of the regressions, other market condition variables could be correlated with the money variable, and omitting them could cause the estimate of the money variable coefficient to be biased. To address these concerns, in this section we perform two further tests: we re-estimate Eq. (1) with controls for changes in the information environment and with controls for market timing.

4.1. Regression results with controls for changes in the information environment

We use two measures to control for changes in the information environment. The first measure we use is the logarithm of the daily return volatility for the past five days (day $t - 5$ to day $t - 1$) of the top 50 liquid stocks, denoted as LN_STD . Higher information asymmetry and more active trading of the top 50 liquid stocks would be associated with higher volatility, so we expect a positive coefficient for LN_STD .

We use the estimator proposed by Parkinson (1980) to calculate the daily return variance. This measure is constructed as follows. We first calculate the daily return variance for each of the top 50 liquid stocks for the past five days using the daily high and low prices:

$$Parkinson_VAR_j = \frac{0.361}{5} \sum_{i=1}^5 \left(\ln \frac{P_{t-i}^H}{P_{t-i}^L} \right)^2. \quad (2)$$

In Eq. (2), $Parkinson_VAR_j$ is the variance of stock j measured over the past five days (day $t - 5$ to day $t - 1$), 0.361 is a scalar, and P_{t-i}^H and P_{t-i}^L are the intraday high and low prices of day $t - i$ ($i = 1, 2, \dots, 5$) for stock j . The advantage of the Parkinson extreme value method of calculating stock variances is that it requires 80% less data to achieve the same efficiency in the variance estimation compared to traditional measures that use daily closing prices. Using the estimates for the individual stocks, we calculate the equally weighted average of the daily return variance for the top 50 stocks. Finally, we take the natural logarithm of the square root of the average daily return variance. That is, on any given day t , LN_STD is calculated as follows:

$$LN_STD = \ln \left[\sqrt{\frac{1}{50} \sum_{j=1}^{50} Parkinson_VAR_j} \right]. \quad (3)$$

The mean (standard deviation) for LN_STD is -3.78 (0.23) for 1993–1998, -3.37 (0.24) for 1999–2000, and -3.18 (0.23) for 2001, respectively. Note that these statistics are expressed in natural logarithms, and the average volatility (daily return standard deviation) for the three subperiods is 2.28%, 3.44%, and 4.16%, respectively.

The second measure, $PESPRD$, is the average percentage effective spread of the top 50 liquid stocks for the past five days. Higher information asymmetry would result in greater bid-ask spreads for the top 50 liquid stocks. We expect that $PESPRD$ will capture the time variation in the information environment.

The percentage effective bid-ask spread is estimated using the TAQ database. To obtain the percentage effective spread, we first match each transaction with the latest quote that is at least five seconds prior to the trade. The dollar effective spread is defined as the absolute difference between the transaction price and the midpoint of the quote multiplied by two. The percentage effective spread is the dollar effective spread scaled by the average of the bid and ask quotes, expressed in percentages. We first calculate the daily average percentage effective spread for each stock, and then calculate the average for the past five days. We finally take the average of the percentage effective spread of the top 50 stocks for the past five days to obtain *PESPRD*. For exposition purposes, we multiply *PESPRD* by 100 in the regressions so that it is expressed in basis points.

The mean (standard deviation) for *PESPRD*, in basis points, is 15.34 (4.27) for 1993–1998, 8.60 (1.07) for 1999–2000, and 7.04 (2.16) for 2001, respectively. The decrease in the mean value of the bid-ask spread from 1993–1998 to 1999–2000 is consistent with less adverse selection due to a lower proportion of trading by informed investors, possibly due to more churning. Since we expect less IPO-related churning in 2001, however, the continued decrease in the mean value of the bid-ask spread cannot be plausibly explained by this. In addition, the huge drop in the percentage bid-ask spread (by more than 50% from the first to the last subperiod) is too large to be explained merely by an increase in IPO-related churning.

The regression model including the market condition variable(s) is as follows:

$$\begin{aligned}
 \text{Volume} = & \alpha + \eta_1 \text{Date_Index} + \eta_2 \text{SP500} + \sum_{i=1}^4 \lambda_i \text{Weekday}_i \\
 & + \sum_{i=1}^{11} m_i \text{Month}_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i \text{Volume}_{-i} \\
 & + \gamma \text{Aggregate_Money}[0, 5] + \theta \text{Info_Environment} + \varepsilon.
 \end{aligned} \tag{4}$$

We use the logged volatility and the percentage effective spread both separately and jointly to replace the variable *Info_Environment*. The regression results are reported in Table 5. We only report the results using the money left on the table over the six-day aggregation window. All the control variables have similar coefficients to those reported in Table 3, and are not reported. The coefficient on the logged volatility is always positive when used alone, and is statistically significant for the pre- and post-internet bubble periods. The coefficient on the percentage effective spread is positive when used alone, and is marginally significant during the internet bubble period.

The Table 5 results suggest that, even though we control for contemporaneous market returns, the information environment still has an impact on the current day's trading volume. For example, if the daily return volatility of the top 50 stocks is increased from 3.44% to 4.44% (approximately one standard deviation), this 1% increase from the mean, when used alone to control for changes in market conditions, would cause a statistically insignificant 0.92% increase in the current day's trading volume during the internet bubble period.¹² If the percentage effective spread is used alone, an increase of one basis point (one standard deviation) in the past five days' average percentage effective spread would cause a marginally significant 1.19% increase in the current day's trading volume. For all

¹²0.92 = 3.59 × ln(4.44/3.44), where 3.59 is the regression coefficient in the middle panel of Table 5. When *LN_STD* is included, the coefficient on $|R_m|$, which helps to capture the impact of the market-wide volatility, is slightly reduced but remains significant at the 1% level.

Table 5

Regression of trading volume on aggregate money left on the table by IPOs, with controls for information environment change

The model specification is as follows:

$$\begin{aligned}
 \text{Volume} = & \alpha + \eta_1 \text{Date_Index} + \eta_2 \text{SP500} + \sum_{i=1}^4 \lambda_i \text{Weekday}_i \\
 & + \sum_{i=1}^{11} m_i \text{Month}_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i \text{Volume}_{-i} \\
 & + \gamma \text{Aggregate_Money}[0, 5] + \theta \text{Info_Environment} + \varepsilon.
 \end{aligned}$$

The regression model is identical to that reported in Table 4, except that we add *Info_Environment* as a control for changes in the information environment. For *Info_Environment*, we use two variables, the logarithm of the equally weighted daily return standard deviation (*LN_STD*) of the 50 most liquid stocks for the past five days relative to day t ($t - 5$ to $t - 1$) and the average percentage effective spread for the past five days (*PESPRD*, expressed in basis points) for the 50 most liquid stocks. We follow Parkinson (1980) in estimating the return standard deviation. We report the coefficients for the aggregated money variables (measured in units of \$100 million) and the market condition variables only. The coefficients for all of the other control variables are similar to those reported in Table 3. The significance of the variables is indicated using *** (significant at the 1% level), ** (significant at the 5% level), and * (significant at the 10% level). T -statistics, corrected for heteroskedasticity and autocorrelation (Newey and West, 1987), are in parentheses.

Subperiod	Variable	No control for <i>Info_Environment</i>	With <i>LN_STD</i>	With <i>PESPRD</i>	With both
1993–1998	<i>Aggregate_Money</i> [0, 5] _{t}	0.41 (1.32)	0.44 (1.41)	0.39 (1.26)	0.44 (1.40)
	<i>LN_STD</i>		9.71*** (3.25)		12.30*** (3.62)
	<i>PESPRD</i>			0.07 (0.23)	-0.46 (-1.33)
1999–2000	<i>Aggregate_Money</i> [0, 5] _{t}	0.27*** (3.99)	0.28*** (4.24)	0.30*** (4.37)	0.30*** (4.38)
	<i>LN_STD</i>		3.59 (0.68)		-0.51 (-0.09)
	<i>PESPRD</i>			1.19* (1.74)	1.24* (1.78)
2001	<i>Aggregate_Money</i> [0, 5] _{t}	0.29 (0.30)	0.26 (0.27)	0.29 (0.30)	0.24 (0.25)
	<i>LN_STD</i>		19.86* (1.88)		24.17** (2.00)
	<i>PESPRD</i>			0.04 (0.02)	-1.78 (-0.93)

model specifications and all subperiods, however, the coefficients for the money variable remain qualitatively unchanged compared to those in Table 4. Furthermore, our results for the money left on the table coefficients are robust to using three- or ten-day windows. This suggests that the relation identified in Table 4 between money left on the table and the

Table 6

Regression of trading volume on aggregate money left on the table by IPOs and number of IPOs
The model specification is as follows:

$$\begin{aligned}
 \text{Volume} = & \alpha + \eta_1 \text{Date_Index} + \eta_2 \text{SP500} + \sum_{i=1}^4 \lambda_i \text{Weekday}_i \\
 & + \sum_{i=1}^{11} m_i \text{Month}_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i \text{Volume}_{-i} \\
 & + \gamma \text{Aggregate_Money} [0, 5] + \theta \text{Number_IPOs} + \varepsilon.
 \end{aligned}$$

Compared to the regression in Table 4, the additional variable *Number_IPOs* is the number of IPOs on day *t*. In this table we report the coefficients for the aggregated money left on the table (measured in units of hundred millions) variables and the variable *Number_IPOs*. The coefficients for all of the other control variables are not reported. The significance of the variables is indicated using *** (significant at the 1% level) and ** (significant at the 5% level). *T*-statistics, corrected for heteroskedasticity and autocorrelation (Newey and West, 1987), are in parentheses.

Variable	1993–1998	1999–2000	2001
<i>Aggregate_Money</i> [0, 5] _{<i>t</i>}	0.38 (1.29)	0.21*** (3.34)	0.15 (0.16)
<i>Number_IPOs</i>	0.07 (0.23)	0.99** (2.39)	2.18 (1.50)

volume of the top 50 liquid stocks is not driven by changes in the information environment.

4.2. Regression results with controls for market timing

To further disentangle the market-timing hypothesis and the profit-sharing hypothesis, we add another variable, the number of IPOs, to the regression model reported in Table 6:

$$\begin{aligned}
 \text{Volume} = & \alpha + \eta_1 \text{Date_Index} + \eta_2 \text{SP500} + \sum_{i=1}^4 \lambda_i \text{Weekday}_i \\
 & + \sum_{i=1}^{11} m_i \text{Month}_i + \beta_1 R_m + \beta_2 |R_m| + \sum_{i=1}^4 \delta_i \text{Volume}_{-i} \\
 & + \gamma \text{Aggregate_Money} [0, 5] + \theta \text{Number_IPOs} + \varepsilon.
 \end{aligned} \tag{5}$$

The new variable, *Number_IPOs*, is the number of IPOs in our sample on day *t*. If the relation between the volume of the top 50 liquid stocks and IPO activity is mainly driven by investment banks' market-timing abilities, the number of IPOs would better capture this relation than the money left on the table, which is jointly determined by the number of IPOs, the size of the offerings, and the degree of underpricing. In other words, if the relation between volume and IPO activity is driven by market timing rather than profit sharing, we would expect the coefficient on the money left on the table to be dramatically reduced.

We report the regression results in Table 6, where, as in Tables 4 and 5, we do not report the coefficients on the control variables in the interest of brevity. For all three subperiods, both the money left on the table and the number of IPOs are positively related to the volume of the top 50 liquid stocks. The coefficients on the number of IPOs and the money left on the table are only significant, at the 5% level and the 1% level, respectively, during the internet bubble period. Most importantly, the inclusion of this additional variable has only a modest effect on the coefficient of the money left on the table variable during 1999–2000, reducing it from the 0.27 ($t = 3.99$) that we report in Tables 4 and 5 to 0.21 ($t = 3.34$) in Table 6. This suggests that the profit sharing we observe during the internet bubble period is not entirely driven by market timing.

The number of IPOs, however, is economically just as important as the money left on the table in explaining the volume of the 50 most liquid stocks. Since the coefficient on the number of IPOs during the bubble period is 0.99, and there are 1.59 IPOs per day on average, the difference in volume between an average day and a day with zero IPOs is 1.57%. This is approximately the same effect as money left on the table: the coefficient of 0.21 implies that there is a difference of 1.59% in volume between an average day (where the money left on the table variable has a value of \$756 million) and a day with zero money left on the table.

5. Conclusion

The vast majority of IPOs in the last 20 years have been marketed using the bookbuilding process. This process gives the lead underwriter considerable discretion in setting the offer price and allocating shares of the issuing firm. Academic researchers have generally assumed that the lead underwriter uses this allocation discretion in the best interest of the issuer to mitigate information asymmetry. However, recent regulatory investigations, as well as discussions with practitioners, indicate that allocations of underpriced shares are at least partly based on commission business from investors.

Commission revenue equals the product of shares traded and the commission per share. Commission revenue can be tabulated over short periods immediately surrounding IPOs (high-frequency data) or over longer periods (low-frequency data). This paper examines whether there is a high-frequency relation between the money left on the table by IPOs and trading volume. IPO allocation data are confidential, and we use an indirect measure of abnormal commission revenue—the abnormal trading volume of liquid stocks—to capture IPO-related trading.

We find that \$1 billion left on the table during the six trading days commencing with day t (days t to $t + 5$) generates abnormal volume in the 50 most liquid stocks of between 2.7% and 4.1% on day t , although only during the internet bubble period is this point estimate reliably different from zero. This relation between the money left on the table and abnormal trading volume on liquid stocks just prior to the offer date suggests that the gross spread is not the only source of compensation for IPO underwriters.

Our point estimates imply that during 1999–2000, the trading volume of the 50 most liquid stocks was 2.0% higher than it would have been if rent-seeking behavior had not been occurring. Since these stocks represented about 25% of aggregate trading volume, this would suggest that aggregate volume was boosted by 0.5%, a much lower number than the 10% increase that Ritter and Welch (2000) conjecture.

Our results are consistent with the profit-sharing hypothesis that during the bubble period, rent-seeking activity occurred whereby securities firms with hot IPOs to allocate received commission revenue from investors in return for favorable IPO allocations. Our finding of only modest effects on trading volume suggests that to the extent that significant commissions flowed to the brokerage firms in return for favorable IPO allocations, the data indicate that the main instrument was the commission per share rather than trading volume. Furthermore, our finding that trading in the 50 most liquid stocks rises only modestly immediately prior to money being left on the table suggests that the IPO allocations were primarily determined by low-frequency commission business as suggested by Reuter (2006) and/or explicit profit-sharing arrangements using high commissions per share, rather than the high-frequency trading volume relations that we investigate.

Other evidence corroborates this interpretation. Institutional trading volume did not fall dramatically in the post-2000 years, despite less money being left on the table by IPOs. Furthermore, average institutional commissions have fallen from 5.9 cents per share in 2000 to 4.7 cents/share in 2004, according to data from Greenwich Associates reported in Goldstein, Irvine, Kandel, and Wiener (2006).

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