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# IPO Pricing in "Hot" Market Conditions: Who Leaves Money on the Table?

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**ABSTRACT**

This paper explores the impact of investor sentiment on IPO pricing. Using a model in which the aftermarket price of IPO shares depends on the information about the intrinsic value of the company and investor sentiment, I show that IPOs can be overpriced and still exhibit positive initial return. A sample of recent French offerings with a fraction of the shares reserved for individual investors supports the predictions of the model. Individual investors' demand is positively related to market conditions. Moreover, large individual investors' demand leads to high IPO prices, large initial returns, and poor long-run performance.

THE END OF THE NINETIES was one of the hottest IPO markets ever. In this period, both the number of initial public offerings and the level of initial returns have reached unprecedented peaks. Ritter[1] documents that in 1999 and 2000 only, 803 companies went public in the United States, raising about $123 billion and leaving about $62 billion on the table in the form of initial returns. Periodically, such periods of IPO euphoria occur. These so-called "hot issue" markets are characterized by high IPO volumes and high levels of initial return (see Ibbotson and Jaffe (1975) and Ritter (1984)), as well as positive serial correlation of IPO initial returns and correlation between recent levels of initial return and current IPO volume.

Surprisingly, however, pre-IPO shareholders do not seem to be upset about leaving so much money on the table. Loughran and Ritter (2002) explain this phenomenon by the fact that insiders of IPO companies consider not only the shares they sell in the IPO, but also those they retain, which benefit from the large initial price run-up. Ljungqvist and Wilhelm (2003) show that during the 1999 to 2000 period, IPO companies were significantly different from usual

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[1] See the "money left on the table" document on Jay Ritter's IPO web page (http://bear.cba.ufl.edu/ritter/).

IPO candidates in terms of ownership structure, levels of sales and net income, and other characteristics. This may have lowered the incentive of insiders of these companies to reduce underpricing.

Recent evidence suggests another reason why preissue shareholders are not upset about leaving money on the table: Their IPO shares are overpriced. Many of the 803 U.S. IPOs of the 1999 and 2000 frenzy have become "penny stocks" or have been delisted. Using accounting measures, Purnanandam and Swaminathan (2004) show that IPO stocks are heavily overpriced on average compared to their industry peers. They also find that the most overpriced IPOs are also those that exhibit the largest initial returns and the poorest long-term performance. Lee, Shleifer, and Thaler (1991) and Lowry (2003) document that "hot issue" periods coincide with low discounts on closed-end funds, their measure of noise traders' optimism. This result is consistent with Loughran, Ritter, and Rydqvist's (1994) hypothesis that issuers take advantage of "windows of opportunity" periodically offered by overoptimistic investors.

Building on this body of evidence, this paper analyzes the impact of favorable investor sentiment on the pricing, initial return, and long-term performance of IPO stocks.

Evaluating the pricing accuracy of IPO stocks is a hard task because of the difficulty of finding satisfactory comparable seasoned stocks. Therefore, the IPO literature has used indirect measures of pricing accuracy, like initial returns. Assuming that short-term aftermarket equilibrium prices reflect the true value of IPO stocks, asymmetric information theories have been developed to explain the positive initial returns observed universally. Rock (1986) claims that issuers underprice their shares to induce uninformed investors to participate in their offerings. Benveniste and Spindt (1989) develop an information extraction model in which the information about the value of IPO shares, which determines their aftermarket price, is privately held by some large institutional investors. They show that the flexibility offered by the book-building mechanism in terms of IPO share allocation allows underwriters to extract this private information. Voluntary underpricing is the cost issuers have to pay in order to extract this information. Thus, in this model as well as in most of the existing IPO literature, positive initial return is the direct consequence of a voluntary underpricing of IPO shares.

The information extraction theory predicts a partial adjustment to private information collected during the IPO process. The more favorable the information received, the higher the IPO price *and* the degree of underpricing, because informed investors have to be rewarded for communicating favorable information about the stock. Hanley (1993) confirms this partial adjustment empirically. Surprisingly, recent work also documents partial adjustment to public information, that is, a positive link between the "market conditions" prevailing at the time of an offering and its subsequent initial return. Derrien and Womack (2003) show that the initial returns on IPOs in France in the 1992–1998 period were predictable using market returns in the 3-month period preceding the offerings. Using U.S. data, Loughran and Ritter (2002) and Lowry and Schwert (2004) obtain similar results. However, Lowry and Schwert (2004) find that the effect is economically small. Bradley and Jordan (2002) include the 1999 "hot issue" market in their sample and find that more than 35% of initial returns can be predicted using public information available at IPO date. Existing theories of IPO underpricing fail to explain this phenomenon. According to the information extraction theory, IPO underpricing is a cost paid to extract private information only. By definition public information can be obtained at no cost before setting the IPO price.

This evidence raises two important questions. First, why do market conditions have an impact on the aftermarket equilibrium price of IPO shares? Second, why is this impact only partially incorporated into IPO prices? Let us consider the first question. Miller (1977) shows that the price of financial securities subject to divergence of opinion among investors and short-sale constraints is driven by optimistic investors. If the favorable market conditions that prevail at the time of an offering generate overoptimism from some investors about the prospects of the IPO company, the first condition of Miller's result is met. As for the second condition, D'Avolio (2002) shows that short-sale constraints are the most severe for stocks that are small, illiquid, and for which uncertainty is high. These characteristics are shared by most initial public offerings.

In this paper, I assume that Miller's result holds for IPOs, and focus on the second of the two questions above: Why is the impact of market conditions on the aftermarket price of IPO shares only partially incorporated into IPO prices? To answer this question, I develop a model of IPO pricing in favorable market conditions. In this model, based on Benveniste and Spindt (1989), the aftermarket price of IPO shares depends on private information about the intrinsic value of the company *and* on noise trader sentiment, which is publicly observable at the time of the offering. More precisely, noise traders are assumed to be bullish at the time of the offering. They are ready to pay high prices (with respect to the intrinsic value of IPO shares) to acquire the shares sold in the offering. An underwriter collects information from informed institutional investors, prices the IPO, and allocates the shares.

I show that in this framework, the IPO price chosen by the underwriter depends on both the intrinsic value of the company, revealed by institutional investors, and noise trader sentiment: The more favorable noise trader sentiment, the higher the IPO price. However, the information about noise trader sentiment is partially incorporated into IPO prices, and the level of initial return is also positively related to noise trader sentiment. The adjustment to the information about noise trader sentiment is partial because the underwriter is concerned with the aftermarket behavior of IPO shares. Namely, he is committed to providing costly price support if the aftermarket share price falls below the IPO price in the months following the offering. Even though noise trader sentiment is bullish at IPO date, it may turn bearish over the price support period. Therefore, the IPO price results from a trade-off: A higher IPO price increases not only underwriting fees, but also the expected cost of price support. This induces the underwriter to choose a conservative IPO price with respect to the short-term aftermarket price of IPO shares.

The model generates another important result: Since the underwriter sets an IPO price that is between the company's intrinsic value and the price noise traders are ready to pay, IPO shares are overpriced with respect to their long-run intrinsic value. If noise traders are bullish at the time of the offering, underpricing (i.e., the pricing of IPO shares below their true value) is not required to induce informed investors to reveal their information about the firm's value.[2] The incentive to reveal this information is provided by noise traders, who are ready to buy IPO shares at inflated prices on the aftermarket.

This situation is beneficial to informed investors who make a short-term profit by flipping their IPO shares, and to the issuer, who sells overpriced shares. Those who leave money on the table are the overoptimistic noise traders who pay excessive prices for IPO shares on the aftermarket. Ljungqvist, Nanda, and Singh (2003) reach similar conclusions with slightly different assumptions. In their model, noise traders cannot absorb the entire IPO because they are wealth constrained. To induce rational investors to participate in the offering, issuers must set the IPO price below the price noise traders are ready to pay.

The model developed in this paper relies on the assumption that aftermarket price support is costly for the underwriter. In the spirit of Rock (1986), Chowdry and Nanda (1996) develop a model in which price support is used as a complement to underpricing to reduce the losses supported by uninformed investors and induce them to participate in the IPO. Benveniste, Busaba, and Wilhelm (1996) view the underwriter's commitment to price stabilization as a bonding mechanism that prevents underwriters from overpricing new issues. Aggarwal (2000) and Ellis, Michaely, and O'Hara (2000) provide evidence that underwriters intervene to stabilize the price of IPO stocks that exhibit poor aftermarket performance. They find that on average, this practice is not costly because most of the price stabilization is done by covering short positions in IPO shares taken by the underwriter at the time of the offering. However, these costless techniques may not be sufficient to stabilize the prices of heavily overpriced IPOs. Moreover, the costs of overpricing IPO shares with respect to their short-term aftermarket value are not limited to direct price stabilization costs. Booth and Smith (1986) claim that the underwriter's role is to certify that IPO shares are not overpriced. In this model, an underwriter who overprices IPOs loses market shares on the IPO market. This is confirmed empirically by Dunbar (2000). Legal costs may also refrain underwriters from blatantly overpricing new issues, even though investors' demand is very large. Lowry and Shu (2002) report that, though lawsuits following IPOs are relatively rare, litigation costs are large, with settlement payments averaging 11% of the proceeds raised in the offering.

The predictions of the model are tested using a sample of 62 initial public offerings completed on the French stock exchange between 1999 and 2001. These offerings used a unique IPO mechanism: a modified book-building procedure

[2] Note that in this paper, there is a difference between underpricing (the pricing of IPO shares below their true value) and initial return (the short-term aftermarket performance of the stock). In earlier literature, the two terms are equivalent, because the latter is the direct consequence of the former.

in which a fraction of the IPO shares is reserved for individual investors. I explore the link between the demand curves submitted by individual investors, the pricing of IPO shares, and their short- and long-run performances. In line with the predictions of the model, the tests show that:

(i) The demand for IPO shares submitted by individual investors varies considerably, and is strongly related to a measure of market conditions prevailing at the time of the offering, which confirms that individual investors behave like the noise traders in the model;
(ii) Individual investors' demand influences IPO prices to a large extent;
(iii) Initial return and turnover are strongly related to individual investors' demand; and
(iv) The long-term stock price performance of IPO shares is negatively correlated with individual investors' demand. In other words, the more favorable investor sentiment at the time of the offering, the more IPO shares are overpriced.

The rest of the paper is organized as follows. The model is developed in Section I. Tests of the model are presented in Section II, and Section III concludes.

## I. The Model

Consider an issuer who wants to sell one divisible share in an IPO at date 0. The book-building mechanism is used to price and place the IPO share. An underwriter collects information from a group of informed institutional investors a few days before the offering. Right before the IPO share starts trading, the underwriter chooses an IPO price $P_{\mathrm{IPO}}$ and allocates the share in a discretionary manner.[3] The underwriter is committed to providing price support on the secondary market until date 1.[4]

Let $I$ denote the number of informed institutional investors who participate in the offering. These investors are risk neutral. They are not wealth constrained. Each institutional investor submits demand in the IPO process and invests in the IPO if the expected value of the IPO shares on the aftermarket is at least equal to the IPO price. At the beginning of the IPO process, institutional investor $i$, $i \in \{1, \ldots, I\}$, receives a private signal $\sigma_i \in \{\sigma_{\mathrm{B}}, \sigma_{\mathrm{G}}\}$, where $\sigma_{\mathrm{G}}$ (respectively, $\sigma_{\mathrm{B}}$) is a good (respectively, a bad) signal about the intrinsic value of the company, $V$. The intrinsic value of the company $V$ is a random variable uniformly distributed on [0, 1]. The institutional investors' signals are independent and linked to the company's value as follows:

$$\Pr[\sigma_i = \sigma_{\mathrm{G}} \mid \tilde{V} = V] = V. \tag{1}$$

[3] For a detailed description of the book-building mechanism, see for example Cornelli and Goldreich (2001).

[4] The length of the price stabilization agreements signed by underwriters and issuers seems to vary but recent evidence suggests that underwriters stabilize share prices for at least 2 months after their IPO (see Aggarwal (2000) and Ellis et al. (2000)).

Let $k$ denote the number of good signals among the $I$ signals received by institutional investors. We know from Welch (1992) that the expected value of $\tilde{V}$ given that $k$ good signals are received is equal to $\frac{k+1}{I+2}$.

The IPO shares cannot be sold short on the secondary market. Their aftermarket price depends on the firm's intrinsic value and on the sentiment of noise traders about the issuer. Noise traders form a large group of investors, who are assumed to be bullish at the time of the IPO. Let $P_0$ denote the price these investors are ready to pay to acquire the IPO shares. We assume that $P_0 = \frac{k+1}{I+2} + u_0$, where $u_0$ is strictly positive and represents the intensity of noise traders' bullishness at the IPO date. This parameter is publicly observable at the time of the offering. The behavior of noise traders on the secondary market is the following: Their demand for IPO shares is infinite as long as the share price is below $P_0$, and it is equal to 0 if the share price is equal to or greater than $P_0$. In other words, if the IPO price is smaller than $P_0$, noise traders will drive the aftermarket price of IPO shares to $P_0$.

The intensity of noise traders' bullishness can change between the offering date and date 1, the end of the price support period. At date 1, the noise traders' valuation of IPO shares is $P_1 = \frac{k+1}{I+2} + u_1$, where $u_1$ represents the intensity of noise traders' bullishness at this date. As at the IPO date, $u_1$ is a random variable uniformly distributed on $[0, 2u_0]$, so that $\mathrm{E}[u_1 \mid u_0] = u_0$ (on average, noise traders will be as bullish at date 1 as they are at date 0).

The underwriter is risk-neutral and has no private information about the intrinsic value of the IPO company.[5] His goal is to maximize his expected revenues, equal to the sum of IPO fees and the expected cost of price support. IPO fees are a percentage $f$ of the IPO proceeds. They are equal to $f \times P_{\mathrm{IPO}}$. The expected cost of price support depends on $P_{\mathrm{IPO}}$ and on the aftermarket price of the IPO shares. The price support commitment of the underwriter takes the following form: The underwriter offers to buy shares on the aftermarket at $P_{\mathrm{IPO}}$ until date 1.[6]

Let us first determine the expected cost of price support, assuming that the allocation schedule used by the underwriter allows him to extract the information held by institutional investors (i.e., to know $k$). If $P_{\mathrm{IPO}} \leq \frac{k+1}{I+2}$ (i.e., if the IPO price is less than or equal to the expected value per share of the company), price support never occurs because trading among institutional investors guarantees an aftermarket price at least equal to $\frac{k+1}{I+2}$. If $P_{\mathrm{IPO}} > \frac{k+1}{I+2}$, the cost of price support depends on $P_1$, the aftermarket price at the end of the price support period, and is positive if $P_1$ is in $]\frac{k+1}{I+2}, P_{\mathrm{IPO}}[$. In this situation, the underwriter buys the shares at $P_{\mathrm{IPO}}$ and incurs a loss of $P_{\mathrm{IPO}} - P_1 = P_{\mathrm{IPO}} - \frac{k+1}{I+2} - u_1 < 0$. Note that we need not consider aftermarket price movements before date 1.

[5] The underwriter plays a limited role, which consists of extracting private information from investors, as in Benveniste and Spindt (1989). Allowing the underwriter to receive private information about the value of the IPO company does not change the results.

[6] This form of price support is somewhat extreme. This assumption is made for simplicity. The results presented thereafter are valid, as long as the cost of price support is positive when IPO shares are overpriced with respect to their aftermarket value, as well as increasing in the degree of overpricing.

Indeed, if noise traders' bullishness decreases before date 1, the underwriter buys IPO shares at $P_{\text{IPO}}$. He sells them back at $P_{\text{IPO}}$ whenever possible. If not, he still holds them at date 1, incurring a loss of $P_{\text{IPO}} - P_1$.

Therefore,

$$\begin{aligned} \text{E(cost of price support} \mid P_{\text{IPO}}) &= \int_0^{P_{\text{IPO}}-\frac{k+1}{I+2}} \frac{1}{2u_0} \times \left(P_{\text{IPO}} - \frac{k+1}{I+2} - x\right) dx \\ &= \frac{1}{4u_0} \times \left(P_{\text{IPO}} - \frac{k+1}{I+2}\right)^2. \end{aligned} \tag{2}$$

Finally, let $q_{\text{G}}^k$ and $q_{\text{B}}^k$ denote the quantities allocated to an investor announcing, respectively, a good and a bad signal when $k$ good signals are announced.

In order to calculate the expected cost of price support and to choose $P_{\text{IPO}}$, the underwriter needs to know the true value of the IPO company. In other words, he needs to induce truthful signal revelation by informed investors. Therefore, the pricing and allocation schedule designed by the underwriter has to meet two types of constraints. First, participation constraints: Both types of informed investors participate in the offering if their expected profit is non-negative, which is verified as long as $P_{\text{IPO}} \leq P_0$. Second, incentive constraints have to be satisfied: The expected profit of an informed investor cannot be smaller when he announces his signal truthfully than when he lies on his signal. Let us consider an investor who receives a good signal. If he announces his signal truthfully, his profit is equal to $q_{\text{G}}^k \times (P_0 - P_{\text{IPO}}^k)$, where $P_{\text{IPO}}^k$ is the IPO price chosen by the underwriter when he receives $k$ good signals. If he announces a bad signal, his profit becomes $q_{\text{B}}^{k-1} \times (P_0 - P_{\text{IPO}}^{k-1})$. Therefore, the incentive constraint of the investor who receives a good signal is

$$\begin{aligned} &\sum_{i=1}^{I} \Pr[k = i \mid \text{good signal}]\, q_{\text{G}}^{i}\left(P_0 - P_{\text{IPO}}^{i}\right) \\ &\quad \geq \sum_{i=1}^{I} \Pr[k = i \mid \text{good signal}]\, q_{\text{B}}^{i-1}\left(P_0 - P_{\text{IPO}}^{i-1}\right). \end{aligned} \tag{3}$$

Similarly, the incentive constraint for an investor who receives a bad signal is

$$\begin{aligned} &\sum_{i=0}^{I-1} \Pr[k = i \mid \text{bad signal}]\, q_{\text{B}}^{i}\left(P_0 - P_{\text{IPO}}^{i}\right) \\ &\quad \geq \sum_{i=0}^{I-1} \Pr[k = i \mid \text{bad signal}]\, q_{\text{G}}^{i+1}\left(P_0 - P_{\text{IPO}}^{i+1}\right). \end{aligned} \tag{4}$$

From an institutional investor's standpoint, $k$ is a random variable that can take any value in $\{0, \ldots, I\}$. Using Bayes' rule,

$$\Pr[k = i \mid \text{good signal}] = \frac{2i}{I(I+1)} \quad \text{for all } i \text{ in } \{1, \ldots, I\} \tag{5}$$

and

$$\Pr[k = i \mid \text{bad signal}] = \frac{2(I-i)}{I(I+1)} \quad \text{for all } i \text{ in } \{0, \ldots, I-1\}. \tag{6}$$

Therefore, the optimization problem of the underwriter is

$$\text{Maximize} f \times P_{\text{IPO}} - \frac{1}{4u_0} \times \left(P_{\text{IPO}} - \frac{k+1}{I+2}\right)^2, \tag{7}$$

subject to

$$P_{\text{IPO}} \leq P_0, \tag{PC}$$

$$\sum_{i=1}^{I} \frac{2i}{I(I+1)} q_{\text{G}}^{i}\left(P_0 - P_{\text{IPO}}^{i}\right) \geq \sum_{i=1}^{I} \frac{2i}{I(I+1)} q_{\text{B}}^{i-1}\left(P_0 - P_{\text{IPO}}^{i-1}\right), \tag{IC$_\text{G}$}$$

$$\sum_{i=0}^{I-1} \frac{2(I-i)}{I(I+1)} q_{\text{B}}^{i}\left(P_0 - P_{\text{IPO}}^{i}\right) \geq \sum_{i=0}^{I-1} \frac{2(I-i)}{I(I+1)} q_{\text{G}}^{i+1}\left(P_0 - P_{\text{IPO}}^{i+1}\right), \tag{IC$_\text{B}$}$$

$$kq_{\text{G}}^{k} + (I-k)q_{\text{B}}^{k} = 1 \quad \text{for all } k \text{ in } \{0, \ldots, I\}, \tag{AC}$$

where (PC) is the participation constraint, ($\text{IC}_\text{G}$) and ($\text{IC}_\text{B}$) are the incentive constraints for an investor who receives a good and a bad signal respectively, and (AC) is the allocation constraint.

Proposition 1 characterizes the optimal price and an allocation schedule that is consistent with this IPO price and that satisfies the constraints above.

PROPOSITION 1: *The optimal IPO price is*

$$P_{\text{IPO}} = \frac{k+1}{I+2} + 2fu_0.$$

*If the number of institutional investors* ($I$) *is large enough, the following allocation rule satisfies* (PC), ($\text{IC}_\text{G}$), ($\text{IC}_\text{B}$) *and* (AC):

- *set* $q_{\text{G}}^{k} = q_{\text{B}}^{k} = \frac{1}{I}$ *for all* $k$ *in* $\{0, \ldots, I - \overline{k} - 1\}$,
- set $q_{\text{G}}^{k} = \frac{1}{k}$, $q_{\text{B}}^{k} = 0$ for all $k$ in $\{I - \overline{k}, \ldots, I\}$, *with* $\overline{k} = \text{Int}\left[\frac{I}{2u_0(1-2f)(I+2)}\right] + 1$, *where* Int *stands for "integer part."*

*Proof:* Let us first assume that the allocation schedule designed by the underwriter induces truthful revelation by informed investors; that is, that the underwriter knows $k$. He chooses $P_{\text{IPO}}$ to maximize

$$f \times P_{\text{IPO}} - \frac{1}{4u_0} \times \left(P_{\text{IPO}} - \frac{k+1}{I+2}\right)^2. \tag{8}$$

By setting the first derivative of the expression above equal to 0, we obtain

$$P_{\mathrm{IPO}} = \frac{k+1}{I+2} + 2fu_0. \tag{9}$$

We now have to show that the proposed allocation rule satisfies (PC), ($\mathrm{IC_G}$), ($\mathrm{IC_B}$) and (AC), given this IPO price. Note that with the proposed IPO price and allocation schedule, (PC) and (AC) are satisfied. Noting that $P_0 - P^i_{\mathrm{IPO}} = (1-2f)u_0$, $P_0 - P^{i-1}_{\mathrm{IPO}} = (1-2f)u_0 + \frac{1}{I+2}$, $P_0 - P^{i+1}_{\mathrm{IPO}} = (1-2f)u_0 - \frac{1}{I+2}$, and substituting these terms in ($\mathrm{IC_G}$) and ($\mathrm{IC_B}$), we obtain

$$\sum_{i=1}^{I} \frac{2i}{I(I+1)} q^i_{\mathrm{G}}(1-2f)u_0 \geq \sum_{i=1}^{I} \frac{2i}{I(I+1)} q^{i-1}_{\mathrm{B}} \left[(1-2f)u_0 + \frac{1}{I+2}\right], \tag{$\mathrm{IC_G}$)$'$}$$

and

$$\sum_{i=0}^{I-1} \frac{2(I-i)}{I(I+1)} q^i_{\mathrm{B}}(1-2f)u_0 \geq \sum_{i=0}^{I-1} \frac{2(I-i)}{I(I+1)} q^{i+1}_{\mathrm{G}} \left[(1-2f)u_0 - \frac{1}{I+2}\right]. \tag{ICb)$'$}$$

By announcing a bad signal, an investor who receives a good signal decreases the IPO price, which increases his expected short-term return. On the contrary, an investor who receives a bad signal and lies on his signal increases the IPO price. Therefore, an incentive compatible allocation has to favor investors announcing good signals in at least some situations (i.e., for some values of $k$). However, this should not induce investors who receive bad signals to announce good signals. The rest of the proof appears in Appendix A. Q.E.D.

Proposition 1 states that the IPO price chosen by the underwriter takes into account both the information about the intrinsic value of the issuer and noise trader sentiment. This price results from a trade-off between IPO fees and the expected cost of price support. These two parameters increase with the IPO price. The price chosen by the underwriter is conservative with respect to the price $P_0$ noise traders are ready to pay on the aftermarket, because the cost of price support exceeds the gains coming from additional fees in case of overpricing with respect to $P_1$: One dollar of overpricing with respect to the price noise traders are ready to pay at date 1 yields $f$ dollars in additional fees, but costs one dollar in price support.

Note that we consider noise traders as actors of the secondary market only. In fact they may participate in the IPO process. But since their signals are not informative, the underwriter need not consider them when he sets the IPO price (the relevant information about the behavior of noise traders is public). As for allocation, allowing the underwriter to distribute a fraction of IPO shares to noise traders does not change the results, provided that the fraction allocated to noise traders is independent of the company's intrinsic value.

In the proposed allocation schedule the underwriter allocates all the shares to good-signal investors when the number of good signals is large, and the same number of shares to both types of investors otherwise. This allocation schedule is based on the fact that the number of good signals (or equivalently, the value of the company) is more likely to be large for an investor who received a good signal than for a bad-signal investor. In other words, in his calculation of expected profit, the good-signal investor puts a large weight on the high-value states of nature. Being rewarded in these states of nature deters him from lying on his signal. On the contrary, bad-signal investors disregard the states of nature in which the value of the company is large. If they lie on their signal, they increase the IPO price and reduce their short-term profits. Therefore, serving bad-signal investors as generously as good-signal investors in low-value states of nature prevents them from lying.

The parameter $\overline{k}$ that appears in Proposition 1 represents the level of discrimination between good and bad-signal investors imposed by the underwriter. This parameter is decreasing in $u_0$ and increasing in $f$. When the intensity of noise traders' bullishness increases, so too does the short-term profit on IPO shares. Therefore, the incentive for a bad-signal investor to lie in order to obtain more shares also increases. In this case, $\overline{k}$ decreases; that is, discrimination between holders of bad and good signals decreases. Similarly, if the level of fees $f$ decreases, the underwriter becomes less aggressive in terms of IPO pricing, and the short-term profit for the holders of IPO share increases. Again, discrimination between holders of bad and good signals has to decrease to ensure truthful signal revelation from bad-signal investors.

PROPOSITION 2 (Overpricing): *If noise traders are bullish at the time of the offering, IPO shares are overpriced.*

*Proof:* We know from Proposition 1 that $P_{\mathrm{IPO}} = \frac{k+1}{I+2} + 2fu_0$. Therefore, IPO shares are overpriced by $2fu_0$ with respect to their expected intrinsic value. Q.E.D.

Two parameters have a positive impact on the overpricing of IPO shares. First is the intensity of noise traders' bullishness. The larger this parameter at the IPO date, the higher the expected intensity of noise traders' bullishness at the end of the price support period, and thus the higher the incentive for the underwriter to set an aggressive IPO price. Similarly, high IPO fees encourage the underwriter to set high IPO prices.

In previous IPO literature (e.g., Rock (1986) or Benveniste and Spindt (1989)), positive initial returns are the consequence of voluntary underpricing by the issuer. The model above is close to the model proposed in Benveniste and Spindt (1989), with one major difference: In Benveniste and Spindt's model, noise trader sentiment is not considered. Underwriters need to underprice IPO shares to offer a rent to informed institutional investors as an incentive to reveal their signals truthfully. The results obtained above are similar; that is, the discretion offered by the book-building mechanism in terms of IPO share placement allows the underwriter to extract private information held by institutional investors. However, in this model, the rent offered to institutional investors is not paid by the issuer but by noise traders, who are ready to pay high prices for IPO shares.

Note that if noise traders are not bullish when institutional investors submit their signals, this result does not hold, and the situation becomes similar to the one described in Benveniste and Spindt (1989).

There is another difference between the results of the two models: When the impact of noise trader sentiment on the price of IPO shares is considered, positive initial return is no longer the consequence of underpricing (i.e., the pricing of IPO shares below their true value). Rather, it occurs despite overpricing due to partial adjustment to public information, as stated in Proposition 3.

PROPOSITION 3 (Partial adjustment to public information): *The IPO price and the level of initial return increase with the intensity of noise trader sentiment prevailing at the time of the offering.*

*Proof:* The positive relation between noise traders' bullishness and IPO price is a direct consequence of Proposition 1. Initial return is equal to

$$P_0 - P_{\mathrm{IPO}} = \frac{k+1}{I+2} + u_0 - \left(\frac{k+1}{I+2} + 2fu_0\right) = (1-2f) \times u_0. \tag{10}$$

Therefore, as long as $f < 0.5$, initial return increases with $u_0$. Q.E.D.

This result is consistent with the partial adjustment phenomenon documented in previous studies. Hanley (1993) documents a positive relation between IPO pricing with respect to the file range set at the beginning of the book-building process and the level of initial return. Loughran and Ritter (2002) and others find there is partial adjustment to public information, namely the market conditions prevailing at the time of the offering, proxied by the return of market indices in the period leading to the IPO.

It is worth noting that, in this model, there is partial adjustment to public information only. Indeed, the private information communicated by informed investors is fully incorporated into IPO prices. This choice is made by the underwriter, who knows that the impact of private information on the IPO share price does not change on the aftermarket, contrary to noise traders' bullishness.

In sum, these results are consistent with the features of the "IPO puzzle," namely the fact that IPO stocks exhibit large initial returns but poor long-term performance,[7] as well as with the "hot issue" market phenomenon. The first two features of the puzzle (high initial returns and poor long-term performance) are direct consequences of Propositions 2 and 3. As far as "hot issue" markets are concerned, it is in the issuers' interest to time their offerings so as to go public in "hot" markets; that is, in periods when the intensity of noise traders' bullishness is high. Indeed, if they go public in bullish situations, they will raise more money. Therefore, given the time lag between the decision to go public and the offering (generally a few months), we expect periods of high IPO volume to follow periods of high IPO returns.

[7] The long-term underperformance of IPOs is controversial (see Brav and Gompers (1997)). However, it is established at least for some categories of offerings (e.g., small offerings).

Benveniste, Busaba, and Wilhelm (2002) offer an alternative explanation to the "hot issue" markets phenomenon. They develop a model in which underwriters bundle IPOs in the same industry in order to share the costs of information production (i.e., underpricing) between several issuers. Benveniste et al. (2003) confirm that initial returns, though higher when the overall IPO market is "hot," are negatively correlated with the recent number of offerings in the same industry. Lowry and Schwert (2002) show that the level of initial returns of a given IPO cannot be predicted using information on recent initial returns available at the time of filing. They conclude in favor of the IPO bundling theory. However, their results do not seem to hold for the 1998–2000 period. Actually, the two theories are not mutually exclusive, and "hot issue" markets may result from investors optimism and/or financing needs from firms in a particular industry.

## II. Tests of the Model

### *A. Hypothesis Development*

The model developed above shows that investor sentiment can have a significant impact on the pricing of IPOs and on the aftermarket behavior of IPO shares. Loughran and Ritter (2002) and others have provided indirect empirical evidence of this phenomenon using various measures of market conditions as proxies for investor sentiment. The tests that are conducted in this section use a direct measure of this sentiment, namely the demand for IPO shares posted by individual investors in recent French IPOs. These offerings used a mechanism that was created in 1999 and is unique to the French stock exchange: the Offre à Prix Ouvert (OPO), a modified book-building procedure in which a fraction of the IPO shares is reserved for individual investors. These investors are typically small, uninformed occasional players on the stock market. I assume, and confirm below, that they behave like the noise traders of the model developed in the previous section. Using data on the demand curves submitted by individual investors, I explore the relation between investor sentiment, individual investors' demand, IPO pricing, and the short- and long-term stock price performance of IPO shares.

According to the model developed in the previous section, noise trader sentiment affects the pricing and aftermarket behavior of IPO shares. When this sentiment is bullish at the time of the offering, the underwriter sets an IPO price that partially reflects noise traders' bullishness. Despite this aggressive pricing, high demand from noise traders leads to positive initial return. The level of initial return is also related to noise trader sentiment, due to partial adjustment to this public information.

Four hypotheses are derived from the model. Hypothesis 1 is related to the central assumption of the model, namely the fact that the behavior of noise traders depends on their sentiment, which is observable at the time of the offering. Hypotheses 2–4 are related to the predictions of the model regarding the relation between noise traders' demand and (i) the choice of IPO price,

(ii) the initial return and turnover following the offering, and (iii) the long-term performance of IPO shares.

HYPOTHESIS 1: *Individual investors' demand and aftermarket trading activity depend on the noise trader sentiment that prevails at the time of the offering.*

In the model, noise trader sentiment is assumed to be observable at the time of the offering, and to have an impact on noise traders' demand for IPO shares. Moreover, noise traders are assumed to participate in the aftermarket only if they are bullish. If they are not, aftermarket trading is restricted to institutional investors. Assuming that individual investors trade for smaller amounts than institutional investors, we predict smaller average transaction size on the aftermarket when individual investors are bullish and they submit large demand for IPO shares in the IPO process.

HYPOTHESIS 2: *The IPO price is positively related to individual investors' demand.*

This hypothesis is derived directly from Proposition 1.

HYPOTHESIS 3: *Initial return and aftermarket turnover are positively related to individual investors' demand.*

The first part of the hypothesis is a direct consequence of Proposition 3. Moreover, in bullish situations, noise traders buy the shares that are flipped by institutional investors on the aftermarket. Therefore, we expect aftermarket turnover to be positively related to noise traders' demand.

HYPOTHESIS 4: *Long-term stock price performance is negatively correlated with individual investors' demand.*

Proposition 2 establishes that IPO shares are overpriced, on average, when noise trader sentiment is bullish at the time of the IPO. Moreover, the degree of overpricing depends on the intensity of noise traders' bullishness. If this parameter is reflected in individual investors' demand, IPO shares will be more overpriced on average when individual investors' demand is large. Once the effect of noise trader sentiment on the price of IPO shares has disappeared, we should observe poorer stock price performance for the offerings with larger individual investors' demand.

### *B. The OPO Mechanism*

Since 1999, on the Paris stock exchange, issuers can choose to reserve a fraction of the offered shares for the public in an operation called OPO. When a fraction of a book-built offering is placed using the OPO mechanism, investors submit anonymous bids via a broker. Each investor is allowed to submit one order at one price within the preannounced price range. Two types of orders exist: A orders are either explicitly reserved for individual investors or limited to a maximum number of shares (generally 100). B orders are larger, and may be available to institutional investors. Bids are collected by Euronext and transmitted to the underwriter before he sets the IPO price.

Thus, the underwriter has two order books at his disposal: the one that contains institutional investors' orders and the OPO order book, which contains A and B orders. Considering these two order books, the underwriter chooses an IPO price and allocates the shares.[8] The allocation of the shares placed in the regular book-building part of the offering is discretionary. On the contrary, in the OPO part of the offering, investors are served on a pro rata basis. The fraction of the offering allocated to individual investors can be modified with respect to the OPO fraction announced initially. There is no written rule as to when an OPO should be used, or which fraction should be offered to individual investors, or in which conditions this fraction should be modified once demand has been collected. However, discussions with practitioners suggest that the COB, the French equivalent of the SEC, encourages issuers to have an OPO fraction in their offering, and to increase this fraction when the demand from individual investors is large.[9]

### C. The Data

Between June 1999 and June 2001, 73 offerings with an OPO fraction occurred on the French stock exchange (out of a total of 166 offerings). Information was obtained from Euronext for 62 of these 73 offerings:

- the characteristics of the offering (initial price range, announced OPO fraction of the offering, . . .),
- the total number of A and B orders placed at each price within the limits of the initial price range in the OPO part of the offering,
- the total number of shares bid for by individual investors at each price within the limits of the price range,
- the IPO price and the final OPO fraction of the offering, and
- the aftermarket behavior of IPO shares (daily closing price, trading volume, and number of transactions).

Two examples of OPO offerings are presented in Appendices B and C. The Multimania IPO (see Appendix B) is an example of an offering occurring in a bullish market. Multimania is an Internet access provider, which went public in

[8] The IPO price is generally the same for both types of investors. However, on some occasions, for example, privatizations, the price can be slightly lower for individual investors. In the IPO of Orange, France Telecom's mobile branch, individual investors received a 0.5 Euro discount on the 10 Euro share price (this discount was announced before the book-building period started). None of the offerings in our sample applied this discount.

[9] The COB cannot legally force issuers/underwriters to have an OPO fraction in their offering. However, this institution plays an important role in validating the IPO prospectus before the offering starts. This gives the COB a large negotiating power with underwriters. It seems that underwriters were reluctant to use the OPO mechanism, which they do not control as well as the regular book-building, but were strongly encouraged to do so by the COB.

March 2000, right before the peak of the internet bubble. Individual investors' demand in the OPO part amounted to 22.4 millions of shares, whereas 312,000 shares were offered to individual investors. On the contrary, the Hi-media IPO (see Appendix C), which took place 3 months later, is a good example of an IPO occurring in a bearish market. Hi-media belongs to the same industry as Multimania, and its IPO was very similar to the Multimania offering. However, individual investors only bid for 137,402 shares, whereas 309,375 shares were offered to them initially.

### *D. Summary Statistics*

Summary statistics of the sample are presented in Table I.

We observe in Panel A that the OPO method has gained ground over the regular book-building procedure since 1999. Most offerings now have an OPO part. Most of the IPOs in the sample (41) occurred on the Nouveau Marché, created in 1996 to attract young, high-technology companies. Twelve offerings occurred on the Second Marché, designed for small but more established firms, nine on the Premier Marché, the main exchange at the Paris Bourse. Fifteen industries are represented in the sample, but most offerings (45) are concentrated in three industries: Electricity/Electronics/Telecommunications, Information technology, and Communication/Advertising/Broadcasting. This reflects the high-technology and internet boom that occurred in the period we consider.

Panel B of Table I presents statistics on IPO characteristics and individual investors' demand (I only consider A orders, which are only available to individual investors, either explicitly or because they are limited to small numbers of shares). The average offering size is 77.66 MEuros. Premier Marché offerings are larger on average than those occurring on the two other exchanges, but the three exchanges exhibit similar individual investors' bidding behavior. The orders submitted by individual investors are small (1,600 Euros on average). However, the total demand submitted by these investors may not be negligible: The OPO fraction of the offering is oversubscribed 5.97 times on average, with large variability. Some offerings attract a very large individual investors' demand (equal to up to 72 times the announced OPO fraction of the offering), some of them are ignored by these investors. Individual investors' demand is large even when it is compared with the total amount sold in the IPO, with an average total demand of 79.89 MEuros, larger than the average size of the offerings in the sample. Thus, individual investors can play a large role in moving the price of IPO shares on the secondary market.

It is also worth noting that the demand provided by individual investors is not informative in the sense of Benveniste and Spindt (1989). Indeed, a vast majority of orders are placed at the upper limit of the price range (93.19% on average). This shows that the decision made by individual investors is binary: participate in the IPO or not. When they choose to participate, they place orders that are virtually market orders. This can be compared with the results

**Table I**

## Summary Statistics

This table provides descriptive statistics of the variables used in the paper. The sample is 62 offerings completed between June 1999 and June 2001 on the Paris stock exchange. *Width of the initial price range* is the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range. *OPO total demand* is the demand by individuals (A orders only) at all prices within the price range in million Euros. *Order size* is *OPO total demand* divided by the total number of A orders. *OPO oversubscription* is *OPO total demand* divided by the volume (number of shares times mid-point of the price range) initially offered to individual investors. *% of the demand at the upper limit of the range* is the demand by individual investors at the upper bound of the price range divided by their total demand. *IPO price (relative to the price range)* is equal to the IPO price minus lower bound of the initial price range, divided by the width of the range. *Market conditions—3 months* is the return of the industry index to which the IPO company belongs in the 3 months preceding the closing of the order book. *First day turnover* is equal to the first-day trading volume divided by the float. *Transaction size* (*First day in Euros*) is the first-day trading volume divided by the number of transactions on the first trading day. *18-month industry-adjusted performance* is the buy-and-hold abnormal return calculated using industry indices as benchmarks. The other variables are self-explanatory.

Panel A: Number of Observations per IPO Year, Exchange, and Industry

| | | IPO Year | | | |
|---|---|---|---|---|---|
| | | 1999 | 2000 | 2001 | Total |
| Exchange | Premier Marché | 0 | 9 | 0 | 9 |
| | Second Marché | 1 | 7 | 4 | 12 |
| | Nouveau Marché | 2 | 34 | 5 | 41 |
| Industry | Hotels/Restaurants | 0 | 0 | 1 | 1 |
| | Construction/Civil engineering | 0 | 1 | 0 | 1 |
| | Electricity/Electronics/Telecommunication | 0 | 7 | 1 | 8 |
| | Other capital goods | 0 | 1 | 0 | 1 |
| | Household/Professional goods | 0 | 1 | 0 | 1 |
| | Sports/Entertainment | 0 | 1 | 0 | 1 |
| | Beverages | 1 | 0 | 0 | 1 |
| | Specialized consumer retailing | 0 | 2 | 0 | 2 |
| | Information technology | 1 | 18 | 3 | 22 |
| | Communication/Advertising/Broadcasting | 1 | 12 | 2 | 15 |
| | Transport/Storage | 0 | 0 | 1 | 1 |
| | Environment/Collective services | 0 | 2 | 0 | 2 |
| | Real estate | 0 | 1 | 1 | 2 |
| | Insurance | 0 | 2 | 0 | 2 |
| | Other financial institutions | 0 | 2 | 0 | 2 |

Panel B: IPO and OPO Characteristics

| | Mean | Median | Std. Dev. | Max | Min |
|---|---|---|---|---|---|
| IPO size (float in MEuros) | 77.66 | 30.17 | 119.56 | 483.87 | 5.34 |
| Width of the initial price range | 13.74% | 14.44% | 2.72% | 17.82% | 4.00% |
| OPO fraction of the offering (announced) | 13.00% | 10.00% | 4.81% | 30.00% | 5.00% |
| OPO total demand (A orders in MEuros) | 79.89 | 7.44 | 254.98 | 1803.76 | 0.05 |
| Order size (A order in Euros) | 1,600 | 1,394 | 839 | 4,748 | 560 |
| OPO oversubscription (A orders) | 5.97 | 1.93 | 12.38 | 71.91 | 0.02 |
| % of the demand at the upper limit of the range | 93.19% | 95.75% | 7.75% | 99.86% | 58.76% |
| IPO price (relative to the price range) | 56.03% | 64.12% | 43.15% | 100.00% | 0.00% |
| OPO fraction of the offering (realized) | 14.34% | 15.00% | 7.44% | 35.00% | 0.52% |

(*continued*)

**Table I**—*Continued*

| Panel C: IPO Price | Number of Observations |
|---|---|
| IPO priced at the upper limit of the range | 25 |
| IPO priced at the lower limit of the range | 19 |
| IPO priced within the limits of the range | 18 |

Panel D: Market Conditions and Aftermarket Data

| | Mean | Median | Std. Dev. | Max | Min |
|---|---|---|---|---|---|
| Market conditions—3 months | 6.49% | −8.85% | 46.77% | 173.68% | −33.39% |
| First-day initial return | 19.09% | 4.62% | 43.93% | 240.91% | −23.30% |
| First-day turnover | 19.00% | 17.71% | 15.21% | 60.98% | 0.29% |
| Transaction size (First-day in Euros) | 15,686 | 10,667 | 15,770 | 63,295 | 775 |
| 18-month unadjusted performance | −51.97% | −74.47% | 55.15% | 208.14% | −96.79% |
| 18-month industry-adjusted performance | 1.92% | −8.85% | 46.69% | 184.29% | −70.25% |

obtained by Cornelli and Goldreich (2001). Exploring the demand curves submitted by institutional investors in book-built offerings, they find that these demand curves contain mostly limit orders and conclude that they are informative.

Panel C presents the number of IPOs priced at the upper bound, at the lower bound, and within the bounds of the initial price range. The three categories are balanced, with 25, 19, and 18 observations, respectively. Note that none of the IPOs in our sample was priced outside its initial price range, though price ranges are not legally binding. Although pricing outside the announced price range is common in the United States, it is very rare in most European stock exchanges.[10] This institutional feature, associated with the limited width of price ranges (equal to 13.74% of the lower bound of the range on average), is likely to reinforce the partial adjustment phenomenon.

Panel D provides statistics on market conditions and aftermarket behavior of IPO shares. Following Derrien and Womack (2003), market conditions are proxied by the return of the industry index the IPO company belongs to in the 3-month period leading to the closing of the order book. This variable exhibits high volatility and a negative median (−8.85%). This is due to the period considered: Most of the IPOs in the sample occurred after the March 2000 crash. It is also worth noting that this market conditions variable exhibits large variability (with a standard deviation of 46.77%), which reflects the large movements of

[10] See Aussenegg, Pichler, and Stomper (2002) for a comparison of pricing practices on Nasdaq and the German Neuer Markt.

the stock market in the period we are considering. With a mean of 19.09%, the level of first-day initial return is in line with previous studies.[11]

Two measures of 18-month stock price performance are presented in Panel D:[12] The unadjusted performance is disastrous, with a mean of −51.97% and a median of −74.47%, and extremely variable (standard deviation: 55.15%). This result comes from the high-technology crash that occurred after March 2000. The 18-month performance is better (mean: 1.92%, median: −8.85%), when it is adjusted using industry index benchmarks—IPO stock prices plunged together with the stock prices of seasoned companies in the same industries.

### *E. Results*

This section presents and discusses tests of the four hypotheses developed above.

HYPOTHESIS 1: *Individual investors' demand and aftermarket trading activity depend on the noise trader sentiment that prevails at the time of the offering.*

Tests of this hypothesis are presented in Table II.

In Panel A, I test the relation between noise trader sentiment and individual investors' demand. I assume that bullish noise trader sentiment for an industry is associated with a recent increase in the stock index of this industry. Thus, our proxy for noise trader sentiment is the market conditions variable, defined as the return of the industry index the IPO company belongs to in the 3-month period preceding the offering. The market conditions variable is split into terciles. Each IPO is assigned to one tercile. Terciles one, two, and three can be seen as corresponding to bearish, intermediate, and bullish market conditions respectively.[13] Individual investors' demand is the sum of A orders submitted in the OPO process.[14]

The first two columns of Table II present the means and medians of individual investors' demand expressed in millions of Euros. The difference between terciles one and two (low and intermediate market conditions) is small. On the contrary, there is a large difference between terciles two and three (intermediate and high market conditions): 13.30 MEuros vs. 225.53 MEuros on average, 3.19 MEuros vs. 55.42 MEuros for the median. These differences are statistically significant at the 5% and 1% level, respectively (see Panel B). The same result holds for oversubscription (in columns 3 and 4): High market conditions

[11] For some offerings, the equilibrium aftermarket price can be reached after slightly more than one trading day. However, none of the subsequent results are modified if the initial return is calculated over a 10-day period.

[12] An 18-month horizon is chosen for the calculation of long-term performance because it is the longer horizon for which data are available for all the offerings of the sample.

[13] Taking less or more than three groups of market conditions does not change the results.

[14] I do not take into account the price at which orders are placed because almost all of them are placed at the upper bound of the price range. Considering only the orders placed at the upper bound of the range does not change the results.

**Table II**

**Individual Investors' Demand and Market Conditions**

This table presents tests of Hypothesis 1. *Total demand (in volume)* is the demand submitted by individual investors (in MEuros). *Oversubscription* is *Total demand (in volume)* divided by the volume (number of shares times mid-point of the price range) initially offered to individual investors. *Market conditions* is the return of the industry index to which the company belongs in the 3-month period leading to the offering. The *3-month market conditions* variable is split into terciles. Each IPO is assigned to one of the terciles. Panel A presents the mean and median values of *Total demand (in volume)* and *oversubscription* depending on the *3-month market conditions* tercile of the offering. Tests of equality of means with unequal variance ($p$-values) appear in Panel B. *Total demand* (respectively, *oversubscription*) mean comparisons between terciles 1 and 3 (and, 2 and 3) of *3-month market conditions* appear in column 1 (respectively, 3) of Panel B. The $p$-values of Mann-Whitney tests of equality of medians of *total demand* (respectively, *oversubscription*) for terciles 1 and 3 (and, 2 and 3) of *3-month market conditions* appear in column 2 (respectively, 4) of Panel B. Panel C presents OLS regressions: The dependent variables are *Total demand (in volume)* (in column 1), *Oversubscription* (in column 2) and *Log_transaction size (First day)*, the natural logarithm of the average transaction size on the first day of trading (in column 3). The explanatory variables are *Log_size*, the natural logarithm of the float in euros; exchange dummy variables; *OPO fraction of the offering (announced); Width of the initial price range*, the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range; three industry dummy variables; and *Market conditions—3 months*. White heteroskedasticity-consistent $t$-statistics are in parentheses. The symbols * (and respectively **, ***) indicate significance at a 10% level (and respectively at a 5% level and at a 1% level).

Panel A: Market Conditions and Individual Investors' Demand

| | Total Demand (in Volume) | | Oversubscription | | |
|---|---|---|---|---|---|
| 3-Month Market Conditions Tercile | Mean (in MEuros) | Median (in MEuros) | Mean | Median | Number of Observations |
| 1 (bad market conditions) | 7.78 | 3.10 | 2.15 | 1.14 | 21 |
| 2 | 13.30 | 3.19 | 2.33 | 1.80 | 21 |
| 3 (good market conditions) | 225.53 | 55.42 | 13.82 | 7.49 | 20 |

Panel B: Tests of Equality of Means and Medians ($p$-Values)

| | Total Demand (in Volume) | | Oversubscription | |
|---|---|---|---|---|
| Between 3-Month Market conditions Terciles | Mean | Median | Mean | Median |
| 1 and 3 | 0.0310** | 0.0001*** | 0.0154** | 0.0013*** |
| 2 and 3 | 0.0352** | 0.0002*** | 0.0168** | 0.0041*** |

(*continued*)

IPOs are oversubscribed 13.82 times on average (7.49 times for the median) by individual investors vs. 2.15 (1.14) and 2.33 (1.80) times for low and intermediate market conditions IPOs, respectively. The differences in means (medians) between the high market conditions tercile and the low and intermediate terciles are statistically significant at the 5% (1%) level.

Panel C of the table presents linear regressions in which individual investors' demand (total demand in column 1, oversubscription in column 2) and the natural logarithm of the average first-day transaction size are explained by

**Table II**—*Continued*

| Panel C: The Determinants of Individual Investors' Demand | | | |
|---|---|---|---|
| Dependent Variable | Total Demand (in Volume) | Oversubscription | Log_Transaction Size (First day) |
| Log_size | 40.10 | 0.04 | 1.05*** |
| | (1.21) | (0.03) | (5.28) |
| Exchange = Premier Marché | −2.55 | −6.15 | −1.03** |
| | (−0.03) | (−1.04) | (−2.15) |
| Exchange = Nouveau Marché | −122.94 | −3.30 | −0.12 |
| | (−1.04) | (−0.72) | (−0.36) |
| OPO fraction of the offering (announced) | 253.63 | −13.87 | −1.18 |
| | (0.65) | (−0.51) | (−0.46) |
| Width of the initial price range | 116.11 | 13.88 | −0.26 |
| | (0.32) | (0.47) | (−0.07) |
| Industry = Electricity/Electronics/ | 85.62 | 6.87 | 0.01 |
| Telecommunication | (1.11) | (1.52) | (0.05) |
| Industry = Information technology | 186.88 | 8.07 | 0.33 |
| | (1.32) | (1.45) | (1.07) |
| Industry = Communication/ | 251.42 | 11.01* | −0.11 |
| Advertising/Broadcasting | (1.43) | (1.85) | (−0.28) |
| Market conditions—3 months | 307.13*** | 20.83*** | −1.28*** |
| | (4.31) | (3.19) | (−4.26) |
| Intercept | −196.75 | 1.03 | 5.81*** |
| | (−1.23) | (0.14) | (7.36) |
| $R^2$ | 0.52 | 0.57 | 0.67 |

characteristics of the offering and market conditions. Market conditions appear to be the only variable with statistically significant explanatory power of individual investors' demand (at a 1% level in the first two columns). The effect of market conditions is also very significant economically: A 1% change in the industry index in the 3 months preceding the offering leads to an average change of 20.83% in oversubscription.

Thus, the level of individual investors' demand is extremely variable and closely related to the market conditions that prevail at the time of the offering. In bullish situations, the very high individuals' demand (equal to more than three times the total amount of the offering on average), which is mostly submitted at market prices, is likely to influence the outcome of the offering and the aftermarket behavior of IPO shares. This result is consistent with the findings of Dorn (2002), who documents that the demand of retail investors on the first trading day of IPO shares is mostly driven by past stock market performance.

In the third column of Table II (Panel C), the dependent variable is the natural logarithm of the average first-day transaction size on the secondary market. I hypothesize that small transactions are associated with the presence of individual investors on at least one side of the transaction (this assumption is verified in Lee and Radhakrishna (2000)). We observe that transaction size is negatively related to market conditions (the coefficient on the market conditions variable is significantly negative at the 1% level). This confirms the link between individual investors' sentiment at the time of the offering and their activity on the secondary market. In other words, it supports the hypothesis that noise traders participate in the aftermarket only when they are bullish. When they are bearish, higher transaction size suggests that institutional investors are mostly responsible for aftermarket trading.

HYPOTHESIS 2: *The IPO price is positively related to individual investors' demand.*

Tests of this hypothesis are presented in Table III.

Panel A presents the number of observations falling in each of the categories obtained by crossing two discrete variables: first, terciles of oversubscription, and second, a dummy variable equal to one if the offering is priced at the upper limit of its price range. The results support Hypothesis 2: 18 of the 21 IPOs that fall in the low oversubscription tercile are priced below the upper bound of the price range. On the contrary, 15 of the 20 IPOs in the high oversubscription tercile are priced at the upper bound of their price range.

Panel B of the table presents logit regressions. The dependent variable of these regressions is a dummy variable equal to one for IPOs priced at the upper bound of their price range. The explanatory variables are IPO characteristics and individual investors' demand variables (total demand in column 1 and oversubscription in column 2). The probability of observing an IPO price equal to the upper limit of the price range increases with individual investors' demand. Both measures (total demand and oversubscription) exhibit significantly positive coefficients (at the 10% and the 1% level, respectively). Thus, the pricing decision is driven by individual investors' demand.

The fact that high demand from a group of investors leads to a high IPO price is not surprising in itself. It is surprising, however, in light of the theories proposed by Benveniste and Spindt (1989) and others, in which only private information has an impact on IPO prices. Individual investors' demand, which contains mostly market orders and is very dependent on public information (market conditions at the time of the offering), does not contain private information. Still, it is a major determinant of IPO prices.

HYPOTHESIS 3: *Initial return and aftermarket turnover are positively related to individual investors' demand.*

Tests of this hypothesis are presented in Table IV.

In Panel A of Table IV, the average (median) level of initial return is equal to 40.29% (20.90%) for IPOs priced at the upper bound of their range, vs. 4.76% (1.86%) for other offerings. The differences between the means and medians of the two groups are statistically significant at the 1% level. This result also holds for first-day turnover.

**Table III**

## Individual Investors' Demand and IPO Pricing

This table presents tests of Hypothesis 2. *Total demand (in volume)* is the demand submitted by individual investors (in MEuros). *Oversubscription* is *Total demand (in volume)* divided by the volume (number of shares times mid-point of the price range) initially offered to individual investors. In Panel A, two discrete variables are crossed and the number of observations in each of the categories is indicated. *Pricing at the upper limit of the price range* is equal to 1 if the IPO is priced at the upper limit of the price range, and 0 otherwise. *Oversubscription* is divided into terciles, and each IPO is assigned to one tercile depending on its *Oversubscription* value. Panel B presents logit regressions: The dependent variable is the *IPO priced at the upper limit of the price range* dummy variable. The explanatory variables are *Log_size*, the natural logarithm of the float in euros; exchange dummy variables; *OPO fraction of the offering (announced); Width of the initial price range*, the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range; three industry dummy variables; and individual investors' demand variables: *Total demand (in volume)* in column 1 and *Oversubscription* in column 2. White heteroskedasticity-consistent $z$-statistics are in parentheses. The symbols * (and respectively **, ***) indicate significance at a 10% level (and respectively at a 5% level, and at a 1% level).

Panel A: OPO Oversubscription and IPO Pricing: Number of IPOs Priced at the Upper Limit of the Price Range (1), and Below This Limit (0), Depending on the Tercile of Oversubscription

| Pricing at the Upper Limit of the Price Range | Tercile of Oversubscription | | |
|---|---|---|---|
| | 1 (Low Oversubscription) | 2 | 3 (High Oversubscription) |
| 0 | 18 | 14 | 5 |
| 1 | 3 | 7 | 15 |

Panel B: The Determinants of *IPO Priced at the Upper Limit of The Price Range*

| Dependent Variable | Pricing at the *Upper* Limit of The Price Range | |
|---|---|---|
| Log_size | 0.27 | 1.12 |
| | (0.41) | (1.02) |
| Exchange = Second Marché | 4.63 | −0.13 |
| | (1.29) | (−0.05) |
| Exchange = Nouveau Marché | 2.80 | −2.63 |
| | (0.93) | (−1.53) |
| OPO fraction of the offering (announced) | −2.34 | 28.41 |
| | (−0.26) | (1.50) |
| Width of the initial price range | 19.45 | 58.31*** |
| | (1.33) | (2.63) |
| Industry = Electricity/Electronics/ | 6.82 | 14.55*** |
| Telecommunication | (1.21) | (2.73) |
| Industry = Information technology | 8.00 | 17.79*** |
| | (1.36) | (2.71) |
| Industry = Communication/ | 6.67 | 15.15*** |
| Advertising/Broadcasting | (1.14) | (2.57) |
| Total demand (in volume) | 0.07* | – |
| | (1.64) | |
| Oversubscription | – | 1.60*** |
| | | (2.69) |
| Intercept | −14.48** | −33.22** |
| | (−1.99) | (−2.46) |
| Pseudo-$R^2$ | 0.40 | 0.64 |

**Table IV**

## Individual Investors' Demand, Initial Return and Turnover

This table presents tests of Hypothesis 3. Panel A presents the mean and median values of first-Day *initial return* and *turnover* depending on the *Pricing at the upper limit of the price range* dummy variable. Also presented are *p*-values of mean comparisons (with unequal variance) and Mann-Whitney comparisons of these variables between the two groups. Panel B presents OLS regressions: The dependent variables are *Initial return* (columns 1 and 2) and *Turnover* (columns 3 and 4). The explanatory variables are *Log_size*, the natural logarithm of the float in euros; exchange dummy variables; *OPO fraction of the offering (announced); Width of the initial price range*, the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range; three industry dummy variables; and individual investors' demand variables: *Total demand (in volume)* in columns 1 and 3, and *Oversubscription* in columns 2 and 4. White heteroskedasticity-consistent *t*-statistics are in parentheses. Panel C presents statistics on first day *Initial return* and *Turnover* for IPOs priced at the upper bound of the price range, depending on whether *OPO oversubscription* was strong (3rd tercile) or weak (1st or 2nd tercile). Also presented are *p*-values of mean comparisons (with unequal variance) and Mann-Whitney comparisons of these variables between the two groups. The symbols * (and respectively **, ***) indicate significance at a 10% level (and respectively at a 5% level, and at a 1% level).

Panel A: First-Day Return and Turnover for IPOs Priced *at the Upper* Limit of the Price Range vs. Other IPOs

| Pricing at the *Upper* Limit of the Price Range | Initial Return Mean | Initial Return Median | Turnover Mean | Turnover Median | Number of Observations |
|---|---|---|---|---|---|
| 0 | 4.76% | 1.86% | 12.54% | 10.48% | 37 |
| 1 | 40.29% | 20.90% | 28.55% | 25.66% | 25 |
| *p*-Value (comparison tests) | 0.0093*** | 0.0002*** | 0.0001*** | 0.0000*** | |

Panel B: The Determinants of *Initial Return* and *Turnover*

| Dependent Variable | Initial Return | | Turnover | |
|---|---|---|---|---|
| Log_size | 0.08 | −0.01 | 0.07** | 0.06** |
| | (1.18) | (−0.21) | (2.62) | (2.32) |
| Exchange = Premier Marché | −0.32 | −0.10 | 0.00 | 0.05 |
| | (−1.16) | (−0.50) | (0.05) | (0.57) |
| Exchange = Nouveau Marché | 0.10 | 0.12 | 0.08 | 0.07 |
| | (0.75) | (0.82) | (1.48) | (1.27) |
| OPO fraction of the offering (announced) | 0.50 | −1.08 | 0.10 | −0.18 |
| | (0.40) | (−1.26) | (0.28) | (−0.47) |
| Width of the initial price range | 0.75 | 1.24 | −0.75 | −0.50 |
| | (0.44) | (0.79) | (−1.18) | (−0.70) |
| Industry = Electricity/Electronics/ Telecommunication | 0.24 | 0.25 | −0.06 | −0.05 |
| | (1.48) | (1.33) | (−1.13) | (−1.06) |
| Industry = Information technology | −0.05 | −0.07 | 0.02 | 0.04 |
| | (−0.31) | (−0.40) | (0.26) | (0.76) |
| Industry = Communication/ Advertising/Broadcasting | 0.18 | −0.13 | −0.01 | −0.06 |
| | (0.78) | (−0.79) | (−0.09) | (−1.06) |
| Total demand (in volume) | 0.001 | – | 0.0002*** | – |
| | (1.18) | | (4.82) | |
| Oversubscription | – | 0.03*** | – | 0.01*** |
| | | (4.37) | | (2.68) |
| Intercept | −0.59 | 0.00 | −0.11 | −0.00 |
| | (−1.22) | (0.00) | (−0.91) | (−0.04) |
| $R^2$ | 0.27 | 0.59 | 0.53 | 0.56 |

(*continued*)

**Table IV**—*Continued*

Panel C: First-Day Initial Return and Turnover for IPOs Priced *at the Upper* Limit of the Price Range after Strong *OPO Oversubscription* vs. Weak *OPO Oversubscription*

| Strong Oversubscription (3rd Tercile) | Initial Return | | Turnover | | Number of Observations |
|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | |
| 0 | 17.11% | 15.62% | 17.53% | 19.10% | 10 |
| 1 | 55.75% | 28.15% | 35.91% | 35.42% | 15 |
| $p$-Value (comparison tests) | 0.0763* | 0.1655 | 0.0007*** | 0.0023*** | |

Panel B of the table presents the results of linear regressions: Initial return and turnover are explained by characteristics of the offerings and individual investors' demand variables (total demand and oversubscription). The impact of individual investors' oversubscription on initial return is positive and economically significant: A one standard deviation increase in oversubscription leads to an average increase of 37% in initial return. This coefficient is significantly positive at the 1% level. Besides, both individual investors' demand variables have a statistically significant positive impact on first-day turnover (at the 1% level).

Let us consider a slightly modified version of the model presented in the previous section. Assume that based on some private information, the underwriter has to choose a binding price range, whose width is smaller than the possible set of values of the IPO company, before he receives signals from institutional investors. In this setting, IPOs will be priced at the upper bound of the price range in two distinct situations: first, when noise trader sentiment is bullish, and second, when noise trader sentiment is bearish *and* the signals of institutional investors suggest that the expected value per share of the IPO company is larger than the upper bound of the price range. In both cases, initial return will be positive, but turnover should be higher in the first case (when noise traders are bullish) than in the second. Indeed, in the first case, bullish investors participate in the secondary market. In the second case, they do not participate, and the aftermarket price movements come only from trading by institutional investors.

This hypothesis is tested in Panel C of Table IV, in which I only consider offerings priced at the upper limit of their price range. These IPOs are divided into two groups: those that occurred in bearish situations (i.e., which belong to the first or second tercile of OPO oversubscription) and those that occurred in bullish situations (i.e., which belong to the third tercile of OPO oversubscription). In the first two columns of Table IV (Panel C), we observe that initial return is higher in the bullish situation (55.75% vs. 17.11% for the mean, 28.15% vs. 15.62% for the median). The same result holds for first-day turnover: 35.91% vs. 17.53% for the mean, 35.42% vs. 19.10% for the median in bullish vs. bearish situations. The average and median levels of turnover of the two groups of offerings are statistically different at the 1% level. Thus, aftermarket trading activity is significantly larger for offerings priced at the upper bound of their price range in bullish situations than in bearish situations.

More generally, the results presented in Table IV show that there is a strong relation between individual investors' demand, initial return, and aftermarket trading activity of IPO shares, validating the model's prediction.

HYPOTHESIS 4: *Long-term stock price performance is negatively correlated with individual investors' demand.*

Tests of this hypothesis are presented in Tables V and VI.

Table V presents linear regressions. In the first three columns of the table, the dependent variable is the raw 18-month stock price performance. The explanatory variables are IPO characteristics, individual investors' demand (total demand in volume and oversubscription), and the natural logarithm of first-day transaction size.

We observe that the three measures of individual investors' bullishness have a statistically significant impact on long-term stock price performance. This impact is negative (and statistically significant at a 1% level) for individual investors' demand variables, and it is also significantly positive at a 5% level for the transaction size variable. Thus, the higher individual investors' demand in the IPO process, the worse long-term performance, and the higher the average transaction size on the aftermarket (i.e., the lower individual investors' participation in the secondary market), the better the performance. This impact is also very significant economically: A one standard deviation increase in oversubscription leads to an average decrease of 12% in long-run performance.

The same results hold when 18-month performance is calculated with respect to the mid-point of the initial price range instead of the IPO price (see Table V, columns 4–6). This allows us to ignore the effect of individual investors' demand on pricing and to concentrate on the price range that is chosen before the IPO takes place. This result shows that in bullish situations, underwriters anticipate the behavior of individual investors and set aggressive price ranges.

In Table VI, I replicate the previous tests with industry-adjusted 18-month performance as the dependent variable.

Adjusted stock price performance is calculated as a Buy-and-Hold Abnormal Return:

$$\text{BHAR} = \prod_{t=1}^{\tau}[1 + R_{it}] - \prod_{t=1}^{\tau}[1 + \text{E}(R_{it})], \qquad (11)$$

where $R_{it}$ is the return of IPO company $i$ on date $t$, and $\text{E}(R_{it})$ is the return of the industry index IPO company $i$ belongs to on date $t$.

The results are very similar to those that appear in Table V: Individual investors' demand variables (first-day average transaction size on the aftermarket) exhibit significantly negative (positive) coefficients at conventional levels. In other words, industry-adjusted performance is negatively

**Table V**

## Individual Investors' Demand and Long-Term Stock Price Performance

This table presents the results of OLS regressions: The dependent variables are the unadjusted 18-month stock price performance, relative to the offering price (in columns 1 to 3), and to the mid-point of the initial price range (in columns 4–6). The explanatory variables are *Log_size*, the natural logarithm of the float in euros; exchange dummy variables; *OPO fraction of the offering (announced); Width of the initial price range*, the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range; three industry dummy variables; *Total demand (in volume)* in columns 1 and 4; *Oversubscription* in columns 2 and 5; and *Log_transaction size (First day)*, the natural logarithm of the average transaction size in euros on the first trading day in columns 3 and 6. White heteroskedasticity-consistent $t$-statistics are in parentheses. The symbols * (and respectively **, ***) indicate significance at a 10% level (and respectively at a 5% level, and at a 1% level).

| Dependent Variable | Unadjusted 18-Month Stock Price Performance (Relative to IPO Price) | | | Unadjusted 18-Month Stock Price Performance (Relative to Mid-Point of the Price Range) | | |
|---|---|---|---|---|---|---|
| Log_size | 0.02 | 0.04 | −0.19** | 0.02 | 0.05 | −0.20** |
| | (0.29) | (0.55) | (−2.26) | (0.29) | (0.56) | (−2.31) |
| Exchange = Premier Marché | −0.24 | −0.18 | 0.21 | −0.22 | −0.16 | 0.25 |
| | (−0.68) | (−0.55) | (0.66) | (−0.61) | (−0.49) | (0.78) |
| Exchange = Nouveau Marché | −0.48* | −0.52** | −0.23 | −0.49* | −0.53* | −0.23 |
| | (−1.85) | (−2.04) | (−0.92) | (−1.78) | (−1.97) | (−0.88) |
| OPO fraction of the offering (announced) | 0.40 | 0.62 | 0.66 | 0.41 | 0.66 | 0.78 |
| | (0.32) | (0.52) | (0.55) | (0.32) | (0.54) | (0.63) |
| Width of the initial price range | 2.55 | 2.52 | 2.01 | 2.79 | 2.76 | 2.33 |
| | (1.45) | (1.42) | (1.04) | (1.52) | (1.49) | (1.17) |
| Industry = Electricity/Electronics/Telecommunication | −0.19 | −0.20 | −0.33 | −0.19 | −0.20 | −0.34* |
| | (−1.01) | (−1.06) | (−1.64) | (−1.00) | (−1.06) | (−1.68) |
| Industry = Information technology | 0.04 | 0.07 | −0.22 | 0.06 | 0.10 | −0.20 |
| | (0.15) | (0.30) | (−0.96) | (0.24) | (0.40) | (−0.89) |
| Industry = Communication/Advertising/ | 0.13 | 0.17 | −0.11 | 0.14 | 0.19 | −0.11 |
| Broadcasting | (0.49) | (0.66) | (−0.49) | (0.50) | (0.69) | (−0.48) |
| Total demand (in volume) | −0.0006*** | – | – | −0.0006*** | – | – |
| | (−3.15) | | | (−3.10) | | |
| Oversubscription | – | −0.01*** | – | – | −0.01** | – |
| | | (−2.65) | | | (−2.50) | |
| Log_transaction size (first day) | – | – | 0.20** | – | – | 0.20** |
| | | | (2.35) | | | (2.31) |
| Intercept | −0.62* | −0.72** | −1.76** | −0.66* | −0.78** | −1.86** |
| | (−1.80) | (−2.20) | (−2.35) | (−1.83) | (−2.25) | (−2.35) |
| $R^2$ | 0.17 | 0.18 | 0.17 | 0.15 | 0.17 | 0.16 |
| Number of observations | 62 | 62 | 58 | 62 | 62 | 58 |

**Table VI**

**Individual Investors' Demand and Industry-Adjusted Long-Term Stock Price Performance**

This table presents the results of OLS regressions: The dependent variables are the industry-adjusted 18-month stock price performance, relative to the offering price (in columns 1 to 3), and to the mid-point of the initial price range (in columns 4–6). Buy-and-Hold Abnormal Returns are calculated using the index of the industry the IPO company belongs to as a benchmark. The explanatory variables are *Log_size*, the natural logarithm of the float in euros; exchange dummy variables; *OPO fraction of the offering (announced); Width of the initial price range*, the difference between the lower bound and the upper bound of the initial price range divided by the lower bound of the price range; three industry dummy variables; *Total demand (in volume)* in columns 1 and 4; *Oversubscription* in columns 2 and 5; and *Log_transaction size (first day)*, the natural logarithm of the average transaction size in euros on the first trading day, in columns 3 and 6. White heteroskedasticity-consistent $t$-statistics are in parenthesis. The symbols * (and respectively **, ***) indicate significance at a 10% level (and respectively at a 5% level, and at a 1% level).

| Dependent Variable | Industry-Adjusted 18-Month Stock Price Performance (Relative to IPO Price) | | | Industry-Adjusted 18-Month Stock Price Performance (Relative to Mid-Point of the Price Range) | | |
|---|---|---|---|---|---|---|
| Log_size | 0.02 | 0.04 | −0.16** | 0.02 | 0.05 | −0.15** |
| | (0.31) | (0.58) | (−2.20) | (0.32) | (0.65) | (−2.04) |
| Exchange = Premier Marché | −0.14 | −0.10 | 0.24 | −0.12 | −0.08 | 0.29 |
| | (−0.45) | (−0.32) | (0.80) | (−0.35) | (−0.26) | (0.96) |
| Exchange = Nouveau Marché | −0.42* | −0.46* | −0.21 | −0.45* | −0.49* | −0.22 |
| | (−1.75) | (−1.93) | (−0.88) | (−1.74) | (−1.92) | (−0.97) |
| OPO fraction of the offering (announced) | 0.01 | 0.23 | 0.35 | 0.09 | 0.38 | 0.60 |
| | (0.01) | (0.21) | (0.32) | (0.08) | (0.36) | (0.53) |
| Width of the initial price range | 0.97 | 0.94 | 0.70 | 1.31 | 1.31 | 1.12 |
| | (0.67) | (0.64) | (0.41) | (0.87) | (0.85) | (0.65) |
| Industry = Electricity/Electronics/ Telecommunication | 0.28 | 0.27 | 0.15 | 0.29 | 0.28 | 0.16 |
| | (1.49) | (1.44) | (0.78) | (1.56) | (1.52) | (0.83) |
| Industry = Information technology | 0.33 | 0.36* | 0.10 | 0.38* | 0.42* | 0.15 |
| | (1.57) | (1.76) | (0.52) | (1.72) | (1.94) | (0.81) |
| Industry = Communication/ Advertising/Broadcasting | 0.53** | 0.57** | 0.30 | 0.55** | 0.60** | 0.32* |
| | (2.26) | (2.46) | (1.59) | (2.15) | (2.41) | (1.68) |
| Total demand (in volume) | −0.0005*** | – | – | −0.0005*** | – | – |
| | (−2.97) | | | (−2.81) | | |
| Oversubscription | – | −0.01** | – | – | −0.01* | – |
| | | (−2.15) | | | (−1.71) | |
| Log_transaction size (first day) | – | – | 0.16** | – | – | 0.16** |
| | | | (2.27) | | | (2.12) |
| Intercept | −0.13 | −0.23 | −1.08* | −0.20 | −0.33 | −1.21* |
| | (−0.43) | (−0.79) | (−1.76) | (−0.66) | (−1.11) | (−1.81) |
| $R^2$ | 0.16 | 0.18 | 0.15 | 0.15 | 0.18 | 0.15 |
| Number of observations | 62 | 62 | 58 | 62 | 62 | 58 |

correlated to the demand of individual investors at the time of the offering and to their aftermarket trading activity.

This is surprising if we consider that noise trader sentiment is about the industry the issuer belongs to, not the issuer itself. In other words, if noise trader sentiment is bullish at a given time, we expect both the issuer and the companies in the same industry to be overpriced with respect to their intrinsic values. The linear regressions of Table VI show that the impact of noise trader sentiment on stock prices is larger for IPO companies than for seasoned firms in the same industry. This suggests that the impact of noise trader sentiment on stock prices is not arbitraged away as efficiently for IPO stocks as for seasoned stocks. This may be due to differences in short-sale constraints. In a recent study, D'Avolio (2002) shows that short-sale constraints are larger for stocks that are small, illiquid, or subject to divergence of opinion between investors. Most IPOs in our sample are small and illiquid (after the first few trading days, most of these stocks exhibit low trading volumes). Moreover, divergence of opinion among investors may be larger for IPO stocks than for seasoned stocks in similar industries, because IPO companies have no public records. Furthermore, lock-up constraints following IPOs complicate short sales for this type of stocks.

Previous studies have explored the relation between initial return and long-run stock price performance of IPO shares. Overall, the evidence is inconclusive of a significant link between the two variables. Ritter (1991) finds a negative relation between initial return and long-term performance of IPO shares, but the coefficient obtained in multivariate linear regressions is not statistically significant at conventional levels. Using a different sample of IPOs, Loughran and Ritter (2002) find no relation between initial return and 3-year performance. Interestingly, using initial return as an explanatory variable of 18-month performance, we reach the same conclusion: The regression coefficient is negative but not statistically significant at conventional levels. The implicit pricing constraint imposed by initial price ranges may prevent underwriters from incorporating private information into IPO prices. Therefore, initial return may be influenced by firm-specific variables that have no impact on long-run performance.

These tests provide strong support to Hypothesis 4: When individual investors are bullish about an IPO, the long-term stock price performance of the company is poor on average. This suggests that public information about noise trader sentiment is at least partially incorporated into the IPO price chosen by the underwriter at the time of the offering. When this sentiment is favorable, IPO shares are overpriced. In such situations, the issuer leaves money on the table in the form of positive (and large) initial return. But other investors also leave money on the table.

These investors may or may not be the individual investors who participated in the 62 offerings we studied previously. In unreported calculations, I find that an individual investor who bid for the maximum number of shares allowed in all IPOs occurring in the third tercile of market conditions gained approximately 10% after realistic fees of seven euros per transaction, if she flipped her shares on the first trading day. This number is far below the average initial return of these IPOs due to rationing and transaction fees, but it is still a substantial 1-day return. Individual investors, though they are presumably uninformed, may be rational. If they are, they will behave like the noise traders of the model in the very specific settings of the OPO mechanism; that is, submit large demand in bullish situations and flip IPO shares shortly after they start trading.[15]

Thus, although the empirical results above show the impact of individual investors' demand on IPO pricing and the aftermarket behavior of IPO shares, they do not provide evidence that the individual investors who participate in OPO offerings leave money on the table. They show that these investors behave like the irrational noise traders of the model either because they are irrational themselves, or because they anticipate the behavior of noise traders. The investors who leave money on the table are those who hold the IPO shares when noise trader sentiment turns bearish.

## III. Conclusion

The model presented in this paper considers the impact of noise trader sentiment on the pricing and aftermarket behavior of IPO shares. If noise traders are bullish, they are ready to buy IPO shares at high prices. In this framework, IPO prices reflect the private information collected in the IPO process, and partially the public information (noise trader sentiment) known at the time of the offering. Therefore, IPOs are overpriced (i.e., priced over their long-run intrinsic value) on average, but exhibit positive initial returns.

The predictions of the model are supported by an empirical analysis on 62 book-built IPOs in which a fraction of the shares was reserved for individual investors. I observe the behavior of individual investors and find that their demand is strongly correlated with market conditions that prevail at the time of the offering, their demand has a large impact on the IPO price, it is positively correlated with initial return and turnover, and it is negatively correlated with the long-term stock price performance of IPO shares.

These findings complement the existing theories of IPO initial return, which claim that positive initial returns following IPOs are a cost paid by issuers in order to elicit private information. Indeed, they provide evidence that the pricing and initial return of IPO shares are affected by noise trader sentiment to a large extent. Maybe more importantly, they show that IPO shares can be overpriced when noise trader sentiment is favorable.

Therefore, although IPO companies leave money on the table, other actors in the stock market may also leave some money on the table in the IPO game—those who buy IPO shares on the aftermarket. In this respect, this paper

[15] Consider the model of Section I, with a fraction of the IPO shares reserved for a group of individual investors in the conditions of the OPO mechanism. Let us assume that these investors have no private information and pay a fixed transaction fee. If the number of these individual investors is small enough—that is, if rationing is not too high when total demand is large—a rational investor will only bid for IPO shares when he observes bullish noise trader sentiment.

provides another possible reason why companies going public in "hot" markets are not upset about leaving money on the table: They know that their shares are overpriced at the time of the offering.

The present study implicitly assumes that book-building is the only available flotation mechanism. Although this statement is increasingly true in practice, an interesting normative question would be to study the impact of noise trader sentiment on IPO pricing when other IPO mechanisms are used. Derrien and Womack (2003) show that in "hot" market conditions, auctioned IPOs exhibit lower initial returns than their book-built counterparts, because they incorporate more of the information about market conditions into the IPO price. They interpret this result as a proof of higher pricing efficiency of auction mechanisms. On the other hand, auction mechanisms might also lead to higher overpricing in bullish situations, which may have negative effects on welfare.

## Appendix A

*Proof of Proposition 1:* The incentive constraints of informed investors can be rewritten as follows:

$$(1-2f)u_0\sum_{i=0}^{I-1}(i+1)\left(q_{\mathrm{G}}^{i+1}-q_{\mathrm{B}}^{i}\right)\geq\frac{1}{I+2}\sum_{i=0}^{I-1}(i+1)q_{\mathrm{B}}^{i},\qquad(\mathrm{IC_G})''$$

$$(1-2f)u_0\sum_{i=0}^{I-1}(I-i)\left(q_{\mathrm{G}}^{i+1}-q_{\mathrm{B}}^{i}\right)\leq\frac{1}{I+2}\sum_{i=0}^{I-1}(I-i)q_{\mathrm{G}}^{i+1}.\qquad(\mathrm{IC_B})''$$

Note that if $q_{\mathrm{G}}^{k}=q_{\mathrm{B}}^{k}$ for all $k$ in $\{0,\ldots,I\}$ (if informed investors are treated the same way whatever signal they announce), $(\mathrm{IC_B})''$ is satisfied, but not $(\mathrm{IC_G})''$: Investors with good signals will be induced to announce bad signals. Therefore, good-signal investors have to be rewarded by more generous allocations at least on some occasions.

In the proposed allocation schedule the underwriter allocates the same number of shares to both types of investors, except when $k$ is larger than a given number. With such an allocation schedule, we have $q_{\mathrm{G}}^{k}\geq q_{\mathrm{B}}^{k}$ for all $k$ in $\{0,\ldots,I\}$. Therefore, $q_{\mathrm{B}}^{k}\leq\frac{1}{I}$ for all $k$ in $\{0,\ldots,I-1\}$. Consequently, the right-hand side of $(\mathrm{IC_G})''$ is smaller than $\frac{1}{I+2}\sum_{i=0}^{I-1}\frac{(i+1)}{I}=\frac{I+1}{2(I+2)}$. Therefore, if the left-hand size of $(\mathrm{IC_G})''$ is larger than $\frac{I+1}{2(I+2)}$, $(\mathrm{IC_G})''$ will be satisfied. Let us define $\overline{k}$ as the smallest integer for which the following allocation schedule:

- $q_{\mathrm{G}}^{k}=q_{\mathrm{B}}^{k}=\frac{1}{I}$ for all $k$ in $\{0,\ldots,I-\overline{k}-1\}$,
- $q_{\mathrm{G}}^{k}=\frac{1}{k}, q_{B}^{k}=0$ for all $k$ in $\{I-\overline{k},\ldots,I\}$,

allows the left-hand size of $(\mathrm{IC_G})''$ to be larger than $\frac{I+1}{2(I+2)}$; that is,

$$(1-2f)u_0\sum_{i=0}^{I-1}(i+1)\left(q_{\mathrm{G}}^{i+1}-q_{\mathrm{B}}^{i}\right)\geq\frac{I+1}{2(I+2)}.\qquad(\mathrm{A1})$$

Substituting $q_{\mathrm{G}}^{k}$ and $q_{\mathrm{B}}^{k}$ in the left-hand side of (A1), we obtain

$$(1-2f)u_0\left[\sum_{i=I-\overline{k}-1}^{I-1}\frac{i+1}{i+1}-\frac{I-\overline{k}}{I}\right]\geq\frac{I+1}{2(I+2)},\tag{A2}$$

which yields

$$\overline{k}\geq\frac{I}{2u_0(1-2f)(I+2)}.\tag{A3}$$

Therefore,

$$\overline{k}=\mathrm{Int}\left[\frac{I}{2u_0(1-2f)(I+2)}\right]+1,\tag{A4}$$

where Int stands for "integer part."

Let us now show that given this $\overline{k}$, $(\mathrm{IC_B})''$ is verified for a large enough value of $I$.

Since $q_{\mathrm{G}}^{k}\geq\frac{1}{I}$ for all $k$ in $\{0,\ldots,I-1\}$, the right-hand side of $(\mathrm{IC_B})''$ is larger than $\frac{I+1}{2(I+2)}$. Thus, if the left-hand side of $(\mathrm{IC_B})''$ is smaller than $\frac{I+1}{2(I+2)}$, $(\mathrm{IC_B})''$ will be satisfied.

Substituting $q_{\mathrm{G}}^{k}$ and $q_{\mathrm{B}}^{k}$ in $(\mathrm{IC_B})''$ , the left-hand side of $(\mathrm{IC_B})''$ becomes

$$(1-2f)u_0\left[\sum_{i=I-\overline{k}-1}^{I-1}\frac{I-i}{i+1}-\frac{\overline{k}+1}{I}\right].\tag{A5}$$

If $I-\overline{k}-1\leq i\leq I-1$, then $I-i\leq\overline{k}+1$ and $i+1\geq I-\overline{k}$.

So the expression in (A5) is smaller than

$$A=(1-2f)u_0\left[\sum_{i=I-\overline{k}-1}^{I-1}\frac{\overline{k}+1}{I-\overline{k}}-\frac{\overline{k}+1}{I}\right]=\frac{(1-2f)u_0\overline{k}(\overline{k}+1)(I+1)}{I(I-\overline{k})}.\tag{A6}$$

Since $\overline{k}\leq\frac{I}{2u_0(1-2f)(I+2)}+1$,

$$A\leq(1-2f)u_0\frac{\left\{\left[\frac{I}{2u_0(1-2f)(I+2)}+1\right]^2+\frac{I}{2u_0(1-2f)(I+2)}+1\right\}(I+1)}{I\left(I-\frac{I}{2u_0(1-2f)(I+2)}-1\right)}.\tag{A7}$$

After rearranging the terms of (A7), we obtain

$$A\leq\frac{I+1}{2(I+2)}\times\frac{I^2+6u_0(1-2f)(I+2)I+8u_0^2(1-2f)^2(I+2)^2}{2u_0(1-2f)(I+2)(I-1)I-I^2}.\tag{A8}$$

Therefore, if

$$\frac{I^2+6u_0(1-2f)(I+2)I+8u_0^2(1-2f)^2(I+2)^2}{2u_0(1-2f)(I+2)(I-1)I-I^2}\leq 1, \tag{A9}$$

$A \leq \frac{I+1}{2(I+2)}$ and $(IC_B)''$ is satisfied.

Equation (A9) is satisfied if

$$\frac{I\left[(I-3)-\sqrt{(I-3)^2-16}\right]}{8(1-2f)(I+2)}\leq u_0 \leq \frac{I\left[(I-3)-\sqrt{(I-3)^2-16}\right]}{8(1-2f)(I+2)}. \tag{A10}$$

When $I$ tends to infinity, $\frac{I[(I-3)-\sqrt{(I-3)^2-16}]}{8(1-2f)(I+2)}$ tends to 0, and $\frac{I[(I-3)+\sqrt{(I-3)^2-16}]}{8(1-2f)(I+2)}$ tends to infinity. Therefore, if $I$ is large enough, (A9) is verified for any value of $u_0$, and $(IC_B)''$ is satisfied. Q.E.D.

## Appendix B. Example of an Offering Occurring in Bullish Conditions: The Multimania OPO (March 2000)

- Characteristics of the offering (announced on March 2, 2000):
  - number of shares offered: 1,560,000
  - number of shares reserved for individual investors: 312,000 (20% of the shares offered)
  - price range: 31–36 euros
  - book-building period: March 2, 2000 to March 7, 2000
  - choice of the IPO price: March 7, 2000
  - first trade: March 8, 2000
- IPO price: 36 euros
- Initial return: 186.11%
- Orders submitted in the OPO fraction of the offering:

| Limit Price (in Euros) | Number of Orders | Number of Shares |
|---|---|---|
| | A Orders | |
| 31 | 600 | 52,054 |
| 31.5 | 82 | 7,528 |
| 32 | 176 | 13,685 |
| 32.5 | 103 | 9,921 |
| 33 | 640 | 57,645 |
| 33.5 | 168 | 15,302 |
| 34 | 348 | 27,485 |
| 34.5 | 364 | 34,869 |
| 35 | 1,374 | 116,778 |
| 35.5 | 409 | 37,569 |
| 36 | 242,080 | 22,062,886 |
| Total | 246,344 | 22,435,722 |

(*continued*)

**Appendix B**—*Continued*

| Limit Price (in Euros) | Number of Orders | Number of Shares |
|---|---|---|
| | B Orders | |
| 31 | 29 | 4,696 |
| 31.5 | 7 | 660 |
| 32 | 12 | 1,074 |
| 32.5 | 14 | 16,189 |
| 33 | 12 | 1,228 |
| 33.5 | 7 | 781 |
| 34 | 316 | 26,821 |
| 34.5 | 7 | 570 |
| 35 | 63 | 19,963 |
| 35.5 | 15 | 2,915 |
| 36 | 21,671 | 12,319,930 |
| Total | 22,153 | 12,394,827 |

## Appendix C. Example of an Offering Occurring in Bearish Conditions: The Hi-Media OPO (June 2000)

- Characteristics of the offering (announced on June 1, 2000):
  - number of shares offered: 2,062,500
  - number of shares reserved for individual investors: 309,375 (15% of the shares offered)
  - price range: 10.5–12 euros
  - book-building period: June 1, 2000 to June 6, 2000
  - choice of the IPO price: June 6, 2000
  - first trade: June 7, 2000
- IPO price: 11 euros
- Initial return: −7.27%
- Orders submitted in the OPO fraction of the offering:

| Limit Price (in Euros) | Number of Orders | Number of Shares |
|---|---|---|
| | A Orders | |
| 10.5 | 66 | 4,475 |
| 11 | 58 | 3,867 |
| 11.5 | 20 | 1,240 |
| 12 | 1,126 | 94,151 |
| Total | 1,270 | 103,733 |
| | B Orders | |
| 34.5 | 4 | 900 |
| 35 | 4 | 200 |
| 35.5 | 1 | 100 |
| 36 | 152 | 136,202 |
| Total | 161 | 137,402 |

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