Issuers, underwriters and institutional investors: why they all like the book-building IPO procedure

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Abstract

This paper explains the predominance of the book-building IPO procedure. I develop a model in which uninformed investors subject to fads coexist with a group of informed institutional investors (the underwriter’s coalition). When uninformed investors are bearish, they do not buy IPO shares, but participation of the underwriter’s coalition guarantees the placement of the shares at a price equal to their expected fundamental value. When uninformed investors are bullish, they are ready to pay high prices to acquire IPO shares. Underwriters then take this information into account partially and set high IPO prices (that are above the share fundamental value on average). Despite this inflated pricing, IPO shares still exhibit positive initial returns, which guarantees substantial benefits to both the issuer and the underwriter’s coalition.

The predictions of the model nd support in the data: using a sample of 56 book-built IPOs conducted in France between 1999 and 2001, a fraction of which was reserved for individual investors, I show that the bidding behavior of individual investors is a significant driver of IPO pricing and aftermarket behavior of IPO shares.

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1 Introduction

Originally used in the US, the book-building IPO procedure is gaining ground all over the world. This procedure, contrary to other market-oriented mechanisms, gives most power to underwriters. When this procedure is used, underwriters collect information from institutional investors, choose the IPO price and place shares. In France, for instance, book-building was introduced in 1993. Before this date, two mechanisms were used predominantly: an auction-like procedure, and a fixed-price mechanism. Seven years later, these mechanisms have virtually disappeared; only two IPOs used the auction-like procedure in 1999, none in 2000. As for the fixed-price mechanism, it is only used in some very rare and special cases. The situation is similar in all major markets: Jenkinson, Ljungqvist and Wilhelm (2001) report that by July 1999, about 80% of non-US IPOs were brought to the market using the book-building procedure or very close hybrids.

Some authors tried to understand what makes the book-building procedure so attractive for everybody in the market. A first and natural answer is provided by Jenkinson, Ljungqvist and Wilhelm (2001): over the years, US banks and investors have become more international and more influential in all major stock markets. These actors choose the listing mechanism they know, i.e. book-building, which is virtually the only available procedure in the US (only very small IPOs do not use it).

However, this does not explain why other procedures tend to disappear so fast and so radically in markets where other possibilities are offered. For instance in France, some small IPOs which do not require participation from US banks or investors to succeed choose the book-building procedure. Besides, some underwriters (generally the small ones, which did not have the marketing capacity to place shares in book-built offerings) used to be specialized in other mechanisms. Switching to book-building presumably caused substantial changes in their organization.

Another explanation of the predominance of book-building was proposed by several authors, including Benveniste and Spindt (1989), Benveniste and Busaba (1997) and Sherman (2000). They claim that book-building allows underwriters to incorporate signals received from informed institutional investors into the IPO price, at the cost of some underpricing.
Two features of the book-building mechanism facilitate this information extraction: the possibility given to the underwriter first to choose the IPO price, and second to allocate shares in a discretionary manner.

However, the claim that book-building delivers higher pricing accuracy is doubtful both from a theoretical and an empirical standpoint. On the theory side, Biais and Faugeron (1998) show that the modified auction mechanism available in France does as well as book-building in terms of information extraction. Derrien and Womack (2001) show empirically that this auction procedure does a better job of incorporating information about market conditions (i.e. market momentum and volatility) into the IPO price than the book-building mechanism. These findings challenge the pricing virtues of the latter mechanism. Indeed, if book-building is not able to take into account public information known at the time of an offering (like market momentum and volatility), can we expect the refined mechanism described in Benveniste and Spindt (1989) and designed to extract private information to be implemented properly?

Another strand of the IPO literature focuses on “hot issue markets”, i.e. periods characterized by high IPO volume and high initial returns. Loughran, Ritter and Rydqvist (1984) explain this phenomenon by fads among investors. They claim that issuers take advantage of the “windows of opportunity” created by these fads by going public. Some studies showed the relation between these “hot issue” periods and some measures of market euphoria. Lee, Shleifer and Thaler (1991) show that “hot issue” periods coincide with low discount on closed-end funds, their measure of noise traders’ optimism. Derrien and Womack (2001) show that the initial return on IPOs in France in the 1992-1998 period was predictable using the market return in the months preceding the offerings.

In this paper, I propose a model of how book-built IPOs are priced and placed by underwriters that is consistent with the empirical evidence that the demand for these shares depends on market conditions, i.e. on the behavior of some investors in the market. The model distinguishes between offerings that occur in bullish markets and those that occur in bearish markets: in bullish markets, IPOs are easy to price and place because some investors are willing to buy newly issued shares at high prices. In this situation, however,
book-building is profitable for underwriters, and also for institutional investors, who receive favorable treatment and can sell their shares on the aftermarket at very attractive prices. On the other hand, in bearish markets, placing shares is a more difficult task. In this situation, book-building offers riskless solutions to the underwriter, who can use the signals received from investors in his coalition (i.e. informed institutional investors who participate in IPOs by this underwriter on a regular basis) to choose a price equal to the expected value of the issued shares, and place the IPO shares in the hands of these regular investors. On average, belonging to an underwriter's coalition is profitable: institutional investors gain a lot from IPOs occurring in bullish markets, and lose nothing in IPOs occurring in bearish markets.

More specifically, I use a model derived from Benveniste and Spindt (1989), adding an hypothesis on market “temperature”. Two groups of investors coexist: regular institutional investors, who receive private signals about the value of the IPO company, and uninformed investors, who can be bullish or bearish at the time of the IPO. If they are bullish, they are willing to buy IPO shares at inflated prices. If they are bearish, they do not buy IPO shares. I show that the discretion offered to underwriters by the book-building procedure in share pricing and placement allows them to use the following pricing rule:

- set an IPO price equal to the expected value per share of the IPO company given all signals received from institutional investors when uninformed investors are bearish,
- set an IPO price equal to the upper bound of the initial price range when uninformed investors are bullish.

In a sense, these results are close to those in Benveniste and Spindt (1989) and other supporters of the “signal extraction theory” in the bearish case. The only difference is that in my model, institutional investors do not require an IPO price below the expected share value as an incentive to reveal their private signal. Instead, this incentive is provided by uninformed investors, who are likely to be bullish at the time of the IPO.

One important implication of this model is that on average, book-built IPOs are not underpriced (i.e. priced below their expected value given the information available at the time of pricing).1 On the contrary, when markets are bullish, IPO shares are priced above

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1In this paper, there is a clear distinction between “underpricing” (the pricing of IPO shares below their expected fundamental value) and “initial return” (the difference between IPO price and share value on the
their expected value. This result is at odds with most of the previous literature, which explains the positive initial returns of IPOs by a voluntary underpricing of IPO shares. In this paper, I claim that there is another possible source of positive initial returns: the willingness of some investors to invest in IPOs at high prices at some periods.

A second important implication of this model is that, although IPOs are not underpriced on average, they can exhibit strongly positive market returns in the days following their first trading date. This reconciles two empirical facts that seemed contradictory: first strong positive returns following IPOs on average, and second, disappointing long-term performances of IPO shares.

The model developed in this paper also explains the fact that all major actors on the market (issuers, underwriters and institutional investors) seem to prefer book-building over other market-oriented mechanisms: first, book-building allows these actors to take advantage of the willingness of some investors to buy IPO shares at high prices in hot markets. Second, in more quiet markets, the pricing mechanism used in this procedure allows them to price IPO shares very close to their equilibrium prices on the aftermarket, and to avoid placement risk.

A sample of 56 book-built offerings, with a fraction reserved for individual investors whose demand is observable, provides strong empirical support to the model: first, the demand submitted by individual investors is closely related to market conditions, proxied by the market return in the three months preceding the offering. This validates the “bullishness” hypothesis, which is central in the model. Second, there is a positive relation between individual investors’ demand and the IPO price chosen by the underwriter. In particular, when individual investors’ demand is high, the offerings are priced at the upper bound of their price range in most cases. Third, the offerings priced at the upper bound of their price range exhibit high initial return and turnover. Interestingly, this result is more pronounced for those IPOs that are priced at the upper bound of their price range in bullish situations (vs. those priced at the upper bound of the range despite a bearish market), suggesting that the pricing and short-term behavior of these offerings was mostly driven by individual aftermarket. In previous literature, this distinction is not important since the latter is a direct consequence of the former. Here, it is not the case.
investors.

The rest of the paper is organized as follows. Section 2 describes the book-building mechanism. The model is developed in Section 3. Tests of the model are presented in section 4. Section 5 discusses the findings of the paper and concludes.

2 The book-building mechanism

In this section, I give a brief description of the book-building mechanism. For further detail, see Boehmer and Fishe (2000) or Cornelli and Goldreich (2000). The specificity of the book-building mechanism is the role given to the underwriter, as opposed to market-oriented mechanisms that exist on some exchanges. The timing and main steps of the book-building mechanism are presented in Figure 1.

First, the issuer chooses a lead underwriter. For small offerings, or in less mature markets than in the US, this choice is typically non-competitive. In these cases, the issuer tends to choose the bank with which it had a long-term relationship, e.g. through previous bank loans, as its underwriter. In the US and for large offerings, it is common to observe some degree of competition between potential underwriters. Once the issuer has chosen its underwriter and a syndicate, a negotiation occurs between these actors to set a price range. This price range is only indicative. In practice, the IPO price can be, and is quite often, chosen outside this range.\(^2\)

After setting the price range, a prospectus describing the operation is issued. This prospectus contains detailed information about the company’s prospects and the offering. Then, in a marketing phase (the “road-show”), the issuer and the underwriter meet with potential investors and try and convince them that the offering is a valuable investment. The road-show is also a specificity of the book-building mechanism, which does not exist

\(^2\)Again, there is a difference between the US and other markets that is worth noting. While setting a price outside the initial range is common in the US, it is almost never done on European exchanges.
in fixed-price or auction mechanisms. This feature of the book-building is a consequence of the high degree of underwriters’ involvement when this procedure is used, and of the constant interaction between the actors involved in book-built offerings (issuer, underwriter and institutional investors).

Next, investors submit non-binding orders to the underwriter, who builds a book in which he reports these orders. The orders specify quantities and/or prices. As far as the price is concerned, both limit or market orders are observed. The price offered in limit orders has to be within the bounds of the initial price range. In the course of this book-building process, there can be some additional exchange of information between the underwriter and institutional investors (individual investors being generally kept out of the book-building process), who can revise their bids at any time.

A few days before the IPO, the underwriter closes the book. He sets the IPO price and allocates shares in a discretionary way. These two degrees of freedom left to the underwriter are at the very heart of the book-building procedure, along with the constant information exchange between the underwriter and institutional investors. They allow him to reward investors with generous allocations of (potentially) underpriced shares.

## 3 The model

### 3.1 The benchmark model

Consider an issuer who wants to sell a fixed number of shares \(N\) in an IPO, using the book-building procedure. \(N\) is normalized to 1 without loss of generality. The issuer chooses an underwriter, who is risk-neutral and has no private information about the value \(V\) of

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3 The number of days can actually be as low as one day, as it is the case in the US. In other exchanges, specific rules can increase this number of days. In France, for instance, where the book-building procedure is often coupled with a fixed-price procedure at the same price as the one chosen in the book-building part of the offering, the price is typically chosen a few days before the offering date (on average 5 to 6 trading days).
the company.\textsuperscript{4} $V$ can take any value in $[0; V_H]$.\textsuperscript{5} $V_H$ is known to the underwriter and the institutional investors. $V$ is linked to a parameter $\mu$, a random variable uniformly distributed on the interval $[0; 1]$, which describes the quality of the company, in the following way:

$$V = \mu V_H$$

After collecting signals from the institutional investors who form his coalition, the underwriter chooses an IPO price $P_{IPO}$ in the binding price range $[0; V_H]$\textsuperscript{6} and allocates the IPO shares. The underwriter’s coalition consists of $I$ risk-neutral institutional investors. These investors are not wealth-constrained, and participate in all IPOs by this underwriter. This does not mean that each institutional investor necessarily buys shares in all IPOs by this underwriter, but he always communicates a signal, and invests in a given IPO if the expected value of the IPO shares on the aftermarket is at least equal to the IPO price. After maximizing his revenues, the underwriter always favors members of his coalition relative to other potential investors. That is, if the demand of the coalition is large enough to buy all the shares sold in the IPO, other investors do not receive any shares.

Institutional investor $i, i \in \{1, \ldots, I\}$, receives a private signal $\frac{\gamma}{g}\in\{\frac{\gamma}{g}, \frac{\gamma}{G}\}$. $\frac{\gamma}{g}$ is linked to $\mu$ according to the following probability rule:

$$\Pr[\frac{\gamma}{g} = \frac{\gamma}{G}] = \mu:$$

These signals are communicated to the underwriter before the IPO price $P_{IPO}$ is chosen. Let $k$ be the number of $\frac{\gamma}{g}$ (positive) signals in the $I$ signals received by informed investors.

Before the IPO (and before the underwriter receives any signals from the members of his coalition), the issuer and the underwriter sign a commitment contract. This contract

\textsuperscript{4}In this version of the model, like in Benveniste and Spindt (1989), the underwriter plays a limited role, which only consists in extracting private information from investors. This hypothesis will be relaxed in the next section, in which the underwriter will also have private information about the value of the IPO company.

\textsuperscript{5}Setting the lower bound of $V$ to $0$ does not change the result but makes the exposition simpler.

\textsuperscript{6}In this version of the model, the initial price range $[0; V_H]$ is exogenous and coincides with the set of possible values of the IPO company. These assumptions will be relaxed in the next section.
specifies that the underwriter, after choosing the IPO price, buys the shares sold in the
IPO before placing them. I also assume that the underwriter commits to providing price
support, i.e. to buying shares on the aftermarket if they trade at a price below the offer
price. The IPO is chosen by the underwriter after receiving signals from institutional investors
in his coalition and before the shares trade on the market. The underwriter then allocates
shares in a discretionary manner.

The underwriter’s profits depend on the IPO fees, equal to a given exogenous percentage
f of the IPO proceeds, on the price of the IPO, \( P_{\text{IPO}} \), and on the aftermarket price of the
shares, \( P_1 \). If \( P_1 > P_{\text{IPO}} \), the underwriter receives no additional compensation. Given the
firm commitment and price support hypotheses above, if \( P_1 < P_{\text{IPO}} \), the underwriter has to
buy shares on the market so that the aftermarket price is at least equal to \( P_{\text{IPO}} \).

The share price behavior on the aftermarket depends on whether investors outside the
underwriter’s coalition are willing to invest in the IPO. These investors are risk-neutral,
uninformed, and are bullish with probability \( p \), bearish with probability \( 1 - p \). The “mood”
brullishness or bearishness) of uninformed investors is revealed before the underwriter chooses
\( P_{\text{IPO}} \) and places the shares, but after institutional investors announce their private signals.

Let \( Q_k^B \) and \( Q_k^G \) be the quantities allocated respectively to an investor announcing a
positive \( (\frac{1}{k}^B) \) and a negative \( (\frac{1}{k}^G) \) signal when uninformed investors are bearish and \( k \) positive

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7 The book-building procedure is generally associated with this kind of agreements. The exact role of
underwriters in supporting IPO share prices on the aftermarket is controversial. For a discussion, see for
instance Aggarwal (2000). However, overpricing IPO shares is likely to have a negative impact on an
underwriter’s reputation. One can see the cost incurred by the underwriter in such a situation as a loss in
reputation.

8 For simplicity, I do not consider the possibility of over-allotment options.

9 This hypothesis captures the fact that institutional investors typically reveal their private information
(through their indications of interest) a few days or weeks before an IPO takes place. A strategic investor
would be better off waiting as much as he can before placing his bid, since it would allow him to refine
his perception of uninformed investors’ “mood”. However, even late changes in market conditions have an
impact on the aftermarket behavior of IPO shares. Derrien and Womack (2001) show that in France, a 1%
change in the level of the MIDCAC market index in the week preceding an IPO has an impact of 0.62% on
the first-day return of the IPO stock on average. Moreover, it is in the interest of underwriters, whose goal
is to extract as much information as possible, to avoid such behaviors.
signals (among I) were announced. Let \( q^G_k \) and \( q^B_k \) be the quantities allocated respectively to an investor announcing a positive \((\frac{1}{3}G)\) and a negative \((\frac{1}{3}B)\) signal when uninformed investors are bullish and \( k \) positive signals (among I) were announced.

The timing of the model is presented in Figure 2 below.

Uninformed investors behave as follows, depending on their mood:

- if they are bearish, they do not buy shares, whatever the price is. In that case, the aftermarket share price reflects the signals of the coalition:

\[
P_1 = E(\mu | k \text{ positive signals in I signals}) V_H \]

We know from Welch (1992) that \( E(\mu | k \text{ positive signals in I signals}) \), the expected value of \( \mu \) given that \( k \) \( \frac{1}{3}G \) (positive) signals are received among I signals, is equal to \( \frac{k + 1}{I + 2} \) (see the appendix in Welch (1992) for a proof of this result): Therefore, the aftermarket share price under uninformed investors’ “bearishness” is:

\[
P_1 = \frac{k + 1}{I + 2} V_H : \]

- if uninformed investors are bullish, they buy shares at any price below \( V_H + U \), that is their demand is infinite if the share price is smaller than \( V_H + U \), and equal to 0 if the share price is larger than \( V_H + U \). \( U \) is an exogenous parameter that can be seen as the average initial return in “hot” markets.\(^{10}\) This behavior leads to an immediate increase in share price, and to an aftermarket equilibrium price \( P_1 = V_H + U \).

Proposition 1 states that investors outside the underwriter’s coalition never receive allocations in the IPO process.

**Proposition 1**: Uninformed investors never receive shares in the IPO process.

\(^{10}\)In fact, the initial return is an endogenous variable. Here, I consider it as exogenous in order to keep the model as simple as possible. This assumption will be relaxed in the next section.
Proof. Recall that underwriters maximize their expected revenues, then act in the interest of the members of their coalition. Moreover, the underwriter knows uninformed investors' mood before placing the shares, and cannot set $P_{IPO}$ larger than $V_H$, the upper limit of the initial price range. If uninformed investors are bullish, the underwriter knows that if they do not receive shares in the IPO process, they will buy shares on the aftermarket. This will cause the share price to increase on the aftermarket up to $P_1 = V_H + U$. In this situation, allocating all the shares to investors in the underwriter's coalition will guarantee a short-term profit to these investors. When uninformed investors are bearish, they never buy IPO shares. In that case also, all the shares have to placed with members of the underwriter's coalition. QED.

Given these hypotheses and preliminary results, let us now describe the underwriter's behavior in terms of choice of $P_{IPO}$ and allocation rules in different situations. We have to consider two distinct situations, depending on the uninformed investors' mood. Proposition 2 states that if these investors are bullish, the underwriter will choose the highest possible price ($V_H$) in order to maximize his fees. If they are bearish, the design of the book-building procedure allows the underwriter to choose a price equal to the expected value per share of the company given the signals received from informed investors.

Proposition 2: If the size of its coalition ($I$) is large enough, the following pricing rule allows the underwriter to maximize his expected revenues:

- set $P_{IPO} = V_H$ if uninformed investors are bullish,
- set $P_{IPO} = \frac{k + 1}{1 + 2} V_H$ if uninformed investors are bearish.

The following allocation rule satisfies the incentive compatibility constraints of informed institutional investors:

- if uninformed investors are bearish, set $Q^k_G = Q^k_B = \frac{1}{I}$ for all $k$ in $f0; \cdots; I$,
- in uninformed investors are bullish,
  - set $q^k_G = q^k_B = \frac{1}{I}$ for all $k$ in $f0; \cdots; k_1 I$,
  - set $q^k_G = \frac{1}{k}; q^k_B = 0$ for all $k$ in $fk_1 + 1; \cdots; I$,

where $k_1$ is the number of positive signals below which allocating all the IPO shares to investors with positive signals allows to satisfy the incentive compatibility constraint of these
investors.

Proof. See Appendix A. ■

The pricing rule above amounts to setting the highest possible IPO price ($V_H$) when uninformed investors are bullish, and an IPO price equal to the expected aftermarket price $P_1$ given the signals received from institutional investors when uninformed investors are bearish.

The proposed allocation rule is the following: when uninformed investors are bearish, share the IPO shares equally between institutional investors, whatever signal they announced. In bullish situations, share the IPO shares equally between institutional investors if $k$, the number of positive signals announced, is smaller than or equal to $k_1$. If $k$ is larger than $k_1$, allocate all the IPO shares to investors announcing positive ($\frac{3}{4}$) signals. This allocation rule is designed to satisfy institutional investors' incentive compatibility constraints. Consider an institutional investor with a good (bad) signal. If he announces a bad (good) signal, he will decrease (increase) the IPO price in bearish situations (when this price takes signals into account), but he will decrease (increase) his allocation in bullish situations in some situations (if $k$ is larger than $k_1$). The allocation rule proposed guarantees an expected loss higher than the expected gain for both types of institutional investors.

Let us illustrate this result with a numerical example: take $l = 100$, $p = 0.5$, $V_H = 10$, $U = 1$. In this case, we obtain $k_1 = 73$. In other words, one possible pricing and allocation scheme for the underwriter is:

- if uninformed investors are bearish, set $P_{\text{IPO}} = \frac{k + 1}{102} \times 10$, where $k$ is the number of positive signals announced, and allocate $\frac{1}{100}$ of the IPO shares to each institutional investor, whatever signal he sent,

- if uninformed investors are bullish, set $P_{\text{IPO}} = 10$, and:

- if $k > 73$, allocate all the IPO shares to investors submitting positive signals. (For instance, if $k = 80$, allocate $\frac{1}{80}$ of the IPO shares to each of the 80 institutional investors who submitted positive signals, nothing to institutional investors who submitted negative signals.)
- if \( k < 73 \), allocate \( \frac{1}{100} \) of the IPO shares to each institutional investor, whatever signal he sent.\(^{11}\)

More generally, the value of \( k_1 \) depends on \( \frac{(1 - p) \gamma}{pU(1 + \gamma)} \), which appears in the incentive compatibility constraints of institutional investors and represents the expected gain (loss) from lying for an investor with a positive (negative) signal. When the probability \( p \) of uninformed investors’ “bullishness” or \( U \), the degree of this “bullishness”, increase, so does the incentive to lie on their signals in order to obtain more shares for investors with negative signals. In this case, discrimination between holders of negative and positive signals has to decrease, i.e. \( k_1 \) has to increase. In the previous example, replacing \( p \) and \( U \) by 0.99 and 1000 respectively yields \( k_1 = 87 \): in the bullish case, holders of negative and positive signals have to be treated the same in almost all situations (i.e. for most values of \( k \)) in order to prevent investors with negative signals from lying.

**Proposition 3:**
- IPO shares are overpriced, i.e. priced above their expected value, on average
- the initial return of IPO shares is strictly positive on average.

**Proof.** The proof stems directly from Proposition 2: as far as the first part of the result is concerned, we know from Proposition 2 that when uninformed investors are bullish, the IPO shares are overpriced, and when these investors are bearish, they are priced at their expected value given the signals received from institutional investors. As to the second part of the result, the initial return, which is equal to \( U \) in bullish situations and to 0 in bearish situations, is equal to \( pU > 0 \) on average. QED. ■

This result is at odds with the previous theoretical literature on initial public offerings. Indeed, in previous models like Rock (1986) or Benveniste and Spindt (1989), there was also some positive initial return on average, but this initial return was the immediate consequence of voluntary underpricing by the issuer / underwriter. One can compare the results obtained with this model and those of Benveniste and Spindt (1989). The two models have two major

\(^{11}\) In this example, replacing \( k_1 \) by any integer in \([46; 73]\) allows to comply with the incentives of institutional investors.
diﬀerences: rst, in Benveniste and Spindt (1989), market temperature is constant. As a result, underwriters need to underprice IPO shares to oﬀer a rent to informed institutional investors as an incentive to reveal their signals truthfully. In a sense, the results obtained with the model above are similar, except for the fact that the rent oﬀered to institutional investors is not paid by the issuer but by uninformed investors when these investors are bullish.

Second, in Benveniste and Spindt (1989), the price range is not binding. If it was the case in the model above, underwriters could maximize their expected proﬁts in bullish situations by pricing IPOs at the price individual investors are ready to pay. Initial returns would then be equal to 0 on average in bearish and bullish situations. However, empirical evidence shows that underwriters anchor to the price ranges initially agreed on, and only partially adjust IPO prices to take new information into account (see Hanley (1993)). The following reasons may explain this behavior: rst, in favorable market conditions, the equilibrium market price is very hard to estimate with precision. Second, uninformed investors’ sentiment is likely to be volatile: as we will see in the empirical section of this paper, very late changes in market conditions can inﬂuence the behavior of these investors. Consequently, even in favorable conditions, it is less risky for underwriters to anchor to a price range that was justiﬁed by some value analysis, agreed on with issuers, and “promised” to institutional investors. One should also keep in mind the fact that these institutional investors have long-term relationships with underwriters, are major actors of the IPO business, and beneﬁt from the choice to anchor to the initial price range.

This result is also consistent with the empirical ﬁndings in Derrien and Womack (2001). In a study about the French stock exchange, they show that the initial return of book-built IPOs priced at the upper bound of the initial price range is very sensitive to market conditions (proxied by the mean and standard deviation of daily returns of a market index in the 3-month period leading to the IPO). In other words, when uninformed investors are bullish and a book-built IPO is priced at the upper bound of its initial price range, underpricing is very high. This is much less the case for other IPO procedures. For instance, when an
auction-like procedure available in France\footnote{See Derrien and Womack (2001) for a more detailed description of this mechanism.} is used, initial returns are much less sensitive to market conditions.

Proposition 3 is also consistent with the features of the well-known “IPO puzzle”, namely the fact that IPO stocks exhibit high initial returns but poor long-term performance,\footnote{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).} and the fact that periods of high initial returns are followed by periods of high IPO volume (the “hot issue market” phenomenon). Proposition 3 predicts the first two features of the puzzle (high initial returns and poor long-term performance). As for its third feature (“hot issue markets”), it is in the issuers’ interest to time their offerings so as to go public in “hot” markets, that is in periods when the probability ($p$) of market “bullishness” is high. Indeed, such a behavior increases the probability of a high IPO price for these issuers. Thus, due to the time lag between the decision to go public and the actual IPO (generally a few months), periods of high IPO volume follow periods of high IPO returns.

3.2 A model with endogenous price range

In the benchmark model, the initial price range was exogenous. In this model, it is chosen by the underwriter. Moreover, contrary to the previous model, the underwriter has private information about $V$. This information comes from his inspection of the company prior to the offering.

Let us modify slightly the hypotheses of the benchmark model. In this section, we consider more refined uninformed investors. They know that the value of the IPO company is in $[0; V_H]$. However, their behavior is the same as before, that is, if they are bullish, they will have infinite demand while $P_1 \leq V_H$, 0 demand if $P_1 > V_H$. If they are bearish, they do not buy IPO shares in the IPO process or on the aftermarket.

The underwriter has to choose an initial price range. He receives $S$ signals independently drawn from the same distribution as the signals received by institutional investors. Let $k_U \in \{0; 1; \ldots; S\}$ be the number of positive signals among the $S$ signals observed by the
underwriter. Institutional investors observe $S$, but not $k_U$. Thus, from the underwriter’s point of view, when he selects a price range, $E(\mu) = \frac{k_U + 1}{S + 2}$. After he receives the signals sent by institutional investors, $E(\mu) = \frac{k_U + k + 1}{S + 1 + 2}$.

Let us assume for simplicity that the width of the price range is exogenous and equal to $\zeta$, with $0 < \zeta < V_H$. The underwriter has to choose $P_L$, the lower bound of the initial price range in $[0; V_H - \zeta]$. Let us introduce $k_L$, which verifies $P_L = \frac{k_L + 1}{1 + 2}V_H$. There is a direct correspondence between $P_L$ and $k_L$, but we will use in the calculations $k_L$, the number of positive signals among $I + S$ corresponding to an expected share price of $P_L$. Similarly, define $\zeta_k$ as: $P_L + \zeta = \frac{k_L + \zeta + 1}{1 + 2}V_H$. $k_L + \zeta_k$ is the number of positive signals among $I + S$ that corresponds to an expected share price of $P_L + \zeta$. Other hypotheses and notations are unchanged.

Once $P_L$ is chosen, and after institutional investors communicate their signals, $P_{IPO}$ must be chosen in the price range $[P_L; P_L + \zeta]$. Proposition 4 states that if the size of the underwriter’s coalition is large enough, there exists a $P_L$ in $[0; V_H - \zeta]$ that maximizes the underwriter’s expected profit.

Proposition 4: If $I$, the size of the underwriter’s coalition, is large enough, there exists a $P_L$ in $[0; V_H - \zeta]$; and pricing and allocation rules, that maximize the underwriter’s expected profit.

- Pricing rule:
  - set $P_{IPO} = P_L + \zeta$ if unformed investors are bullish,
  - set $P_{IPO} = P_L$ if unformed investors are bearish and $k + k_U < k_L$,
  - set $P_{IPO} = \frac{k + k_U + 1}{1 + S + 2}V_H$ if unformed investors are bearish and $k_L \cdot k + k_U \cdot k_L + \zeta_k$,
  - set $P_{IPO} = P_L$ if unformed investors are bearish and $k + k_U > k_L + \zeta$.

- Allocation rule:

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14 In other words, institutional investors, who are used to participating in IPOs led by the underwriter, know the effort spent by the underwriter in the inspection of the IPO company, but they do not observe the result of this inspection.

15 This hypothesis is consistent with the facts. The offerings studied in the empirical section of the paper have very similar price range widths.
- if uninformed investors are bearish, set $Q_G^k = Q_B^k = \frac{1}{I}$ for all $k$ in $f0; \ldots ; I$.
- if uninformed investors are bullish,
  - set $q_G^k = q_B^k = \frac{1}{I}$ for all $k$ in $f0; \ldots ; k_2 I$.
  - set $q_G^k = \frac{1}{k}$, $q_B^k = 0$ for all $k$ in $fk_2 + 1; \ldots ; I$.

where $k_2$ is the number of positive signals below which allocating all the IPO shares to investors with positive signals allows to satisfy the incentive compatibility constraints of these investors.

**Proof.** : See Appendix B. ■

This result deserves some comments. Let us start with the second part of the proposition (the pricing and allocation rules). The underwriter’s behavior is the same as in Proposition 2 above: when uninformed investors are bullish, the underwriter sets the highest possible IPO price ($P_{IPO} = P_L + \xi$). When they are bearish, three cases are possible: first, if the number of positive signals is in $f k_L; \ldots ; k_L + \xi k_L$, i.e. if the expected value per share of the company is inside the price range, the underwriter sets an IPO price equal to the expected value per share of the company (as in Proposition 2). Second, if the expected value per share of the company is below the price range (i.e. the number of positive signals is smaller than $k_L$), the underwriter sets the IPO price at the lower bound of the range ($P_{IPO} = P_L$) and provides price support so that $P_1 = P_{IPO}$. Third, if the expected value per share of the company is above the price range (i.e. the number of positive signals is larger than $k_L + \xi k$), the underwriter sets the IPO price at the upper bound of the range ($P_{IPO} = P_L + \xi$) and the share price immediately adjusts to the expected value per share of the company on the aftermarket, due to informed investors’ trading. Note that in this case, the initial return is positive.

The first part of the proposition states that there is an optimal price range (i.e. a $P_L$) for the underwriter given the private signals he received. This price range results from a trade-off between the expected cost of price support in cases of uninformed investors “bearishness” and low expected value of the company relative to the price range chosen, and higher fees obtained from setting a higher price range. When the private signals received by the underwriter before he sets the price range are favorable, his estimation of the value per
share of the company is high, and even with a high price range, the expected costs of price support are low. Consequently, he can afford to choose a high price range

Let us illustrate this situation with the following example: \( I = 100, p = 0.5, f = 7\%, \, \zeta_k = 10 \). Moreover, \( S = 1, k_U = 1 \), which yields \( E(\mu) = \frac{2}{3} \) (from the underwriter’s standpoint). Graph 1 presents the underwriter’s trade-off (the underwriter’s expected profit is derived in Appendix B). The value on the y-axis of Graph 1 is the value of expression (6) that appears in this appendix).

The value of \( k_L \) that maximizes the underwriter’s expected profit is 61. That is, the underwriter will choose \( P_L = \frac{k_L + 1}{I + 2} V_H = 0.61V_H \). The price range will then be: \([0.61V_H; 0.71V_H]\).

The underwriter makes a trade-off between the expected gain in fees and the expected loss (i.e. the expected cost of price support) obtained by increasing the lower bound of the initial price range.

In this example, the price range chosen by the underwriter is conservative due to the expected cost of price support, which is probably over-estimated given the form of price support specified in the hypotheses. Indeed, the private signals he received suggest that \( E(V) = \frac{2}{3}V_H \). Thus, contrary to the results obtained in the previous section, the IPO shares can be priced below their expected value even if the uninformed are bearish. In this example, the IPO shares will be priced below their expected value, if the uninformed are bearish and \( k + k_U + 1 > 0.71 \), i.e. \( k > 72 \).

Let us now consider the aftermarket equilibrium price \( P_1 \) and the expected initial return in the context of this numerical example.

- if uninformed investors are bullish, \( P_{IPO} = 0.71V_H \), and \( P_1 = V_H \). The initial return is then equal to \( \frac{V_H}{0.71V_H} = 41\% \). More generally, the more negative the private signal

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16 The underwriter would clearly be better off receiving a large number of signals, which would refine his estimation of the company's value. However, receiving a large number of signals has a cost. For simplicity, I do not model the trade-off between high inspection costs and precise company's estimation, which results in an optimal number of private signals received in the inspection phase.
nals received by the underwriter, the lower $P_L$, and the higher the initial return in bullish situations,

- if uninformed investors are bearish and $k_U + k < k_L$ or $k_L + 6$ $k_U + k 6 k_L + \xi_k$, the initial return is equal to 0 (in the first case, IPO shares are priced at their expected value, in the second case, price support by the underwriter guarantees that $P_1 = P_{IPO}$),

- if uninformed investors are bearish and $k_U + k > k_L + \xi_k$, $P_{IPO} = \frac{k_L + \xi_k + 1}{1 + S + 2} V_H$, and $P_1 = \frac{1}{1 + S + 2} V_H$. Then, the initial return is equal to $\frac{k + k_U + k L + 6}{1 + S + 2} V_H$. In sum, in the context of this numerical example, the expected IPO price is equal to $0.71 V_H + (1 - p) \frac{1}{3} \frac{2}{3} \frac{2}{3} i = 0.68 V_H$.

That is, the IPO is overpriced on average by $\frac{2}{3} = 2\%$. However, the expected degree of initial return is equal to:

$$p = 41\% + (1 - p) \frac{1}{3} \frac{2}{3} \frac{2}{3} i = 0.68 \frac{2}{3} \frac{2}{3} i = 21\%.$$  

In sum, despite the costly price support scheme implemented in the model, the price range chosen by the underwriter still leads to some positive expected overpricing and to some positive expected initial return.

4 Tests of the model

4.1 The data

In this section, I test empirical hypotheses derived from the models above, using 56 book-built offerings completed on the French stock exchange between June 1999 and June 2001. The specificity of these offerings lies in the fact that a fraction of the shares issued were
reserved for individual investors. Using the demand curves submitted by these investors, and assuming that they can be seen as the uninformed investors in the models above, I explore the relation between the demand curves submitted by these agents, the IPO price chosen by the underwriter, and the short-term behavior of the shares issued.

Since 1999, on the Paris stock exchange, issuers can choose to reserve a fraction of the offered shares for the public, generally 10%, in an operation called Oùre à Prix Ouvert (OPO). When a tranche of a book-built offering is placed by OPO, investors submit anonymous price / quantity bids via a broker. Two types of orders exist: A orders are either explicitly reserved for individual investors or limited to a number of shares (most of the time 100). B orders are either reserved for other investors or for large orders. Given that each investor can only submit one bid, I hypothesize that A orders come predominantly from individual investors. Bids are collected by Euronext, and transmitted to the underwriter before he sets the IPO price. Thus, the underwriter has two “books’ at his disposal: the regular institutional investors’ book, and the OPO book with A and B orders. Considering these books, the underwriter chooses an IPO price in the price range and allocates the shares. The allocation of the shares placed in the book-building fraction of the offering is discretionary, as in regular book-built offerings. On the contrary, individual investors are served on a pro rata basis. Depending on the level of individual investors’ demand, the fraction of the offering allocated to individual investors can be increased, or decreased, relative 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 increased or decreased once demand has been collected. However, discussions with practitioners suggest that the COB, the French equivalent for the SEC, encourages issuers to have an OPO tranche in their offering, and to increase this tranche when the demand from individual investors is strong. For an example, see the Gi...OPO in Appendix C.

17 The IPO price is generally the same for both types of investors. However, in some occasions, e.g. in IPOs of state-owned companies, the price can be slightly lower for individual investors. In the case of the IPO of Orange, France Telecom’s mobile branch, in February 2001, 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 my sample applied this discount.

18 The COB can not legally force issuers/underwriters to have an OPO fraction in their offering. However,
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). I obtained information from Euronext for 65 of these 73 OPOs, but decided to eliminate the 9 offerings that occurred on the Premier Marché, the main exchange at the Paris Bourse. These offerings were much larger, and some of them concerned partial privatizations, in which the incentives of the issuer (the Government) may differ from those of a regular issuer. This information consists in:

- 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 tranche of the offering,
- the total number of shares bid for by individual investors at each price within the limits of the price range,
- the outcome of the offering (IPO price, number of shares allocated in the OPO fraction of the offering),
- the aftermarket behavior of IPO shares (price, volume).

4.2 Descriptive statistics

Descriptive statistics of the sample are presented in Table 1 below.

[Insert Table 1 about here.]

The descriptive statistics that appear in Table 1 show that the OPO method has gained ground over the regular book-building procedure since 1999. Most offerings now have an OPO fraction. Most of the IPOs in the sample (43) occurred on the Nouveau Marché, created in 1996 to attract young, high-technology companies. The other 13 OPOs occurred this institution plays a large role in authorizing IPOs and in validating the IPO prospectus before the offering starts. This gives the COB a large negotiating power with underwriters. In fact, 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 forced to do so by the COB.

19 Keeping these 9 Premier Marché offerings in the sample does not change the results presented hereafter.
on the Second Marché, designed for more established firms. The average offering size is 33.7 M Euros. The two exchanges exhibit similar offering size and individual investors’ bidding behavior.

Panel C of the table focuses on the orders submitted by individual investors (A orders). The size of these orders is small (1,470 Euros on average), confirming that most of them probably come from individual investors. However, the total demand submitted by these investors is not negligible; the OPO fraction of the offering is over-subscribed 5.35 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), some of them are ignored by these investors. The weight of individuals is large even when one compares it to the total amount sold in the IPO, with an average total demand of 43.51 M Euros, larger than the average size of the offerings in the sample. This shows that individual investors can play a large role in moving the price of the stocks on the aftermarket.

It is also worth noting that the demand curves provided by individual investors are not very informative in the Benveniste and Spindt sense. Indeed, a vast majority of orders are placed at the upper limit of the price range (92.81% on average). This shows that the decision made by individual investors is binary: participate or not. When they choose to participate, they place orders that are virtually market orders. This can be compared with the result obtained by Cornelli and Goldreich (2000). Exploring the books built by one underwriter, they note that the demand curves in these books are quite informative, i.e. they contain mostly limit orders. Here, individual investors do not communicate opinions about the value of the shares issued. Instead, their decision is about participating or not in the offering.

Panel D presents the number of IPOs priced at the upper bound, at the lower bound, or within the bounds of the price range. The three categories are balanced, with 22, 19 and 15 observations respectively.

Panel E provides statistics on market conditions, proxied by the returns of industry indices over the 3-month and 1-week periods leading to the closing of the OPO.\textsuperscript{20} We observe that these variables exhibit high volatility and negative medians (-9.91% and -0.20% for the

\textsuperscript{20}This time length was chosen following Derrien and Womack (2001).
3-month and 1-week variables respectively. This is due to the period studied: most of the IPOs in the sample occurred after the March 2000 crash. Finally, statistics on 1st-day initial return and 1st-day turnover are presented. With a mean of 18.73%, the level on initial return is in line with previous studies.

4.3 Testable implications

According to the models developed in the previous section, uninformed investors are bullish in some situations, bearish in others. When they are bullish, the underwriter sets an IPO price equal to the upper bound of the price range. Despite this high pricing, the initial return is strictly positive and the turnover is high due to the participation of uninformed investors in the aftermarket. On the contrary, when these investors are bearish, the underwriter chooses an IPO price that reflects the information provided by institutional investors through their indications of interest. Cornelli and Goldreich (2000) observed the behavior of institutional investors and confirmed the information extraction hypothesis formulated in Benveniste and Spindt (1989). Here, we observe the behavior of individual investors.

Let us posit that the individual investors who participate in OPOs are the uninformed investors of the model. Indeed, these individual investors, who bid for small sums (the average bid size is 1,470 Euros), do not have the time and expertise needed to form a precise opinion about IPO candidates. Moreover, these investors may not have a good knowledge of the stock market mechanisms, and may be subject to fads.

Three hypotheses are tested: the first is a validation of a central hypothesis of the models, namely the fact that uninformed investors behave differently, and predictably so, in different market conditions. Hypotheses 2 and 3 test two important predictions of the models: first, the uninformed investors’ behavior influences the choice of IPO price made by the underwriter. Second, this behavior also influences the level of initial return and aftermarket volume of the issued stock. These hypotheses are the following:

\[ \text{For some small offerings, the equilibrium aftermarket price can be reached after slightly more than one trading day. However, the 1st-day closing price is always very informative, and none of the subsequent results are modified if the initial return is calculated over a 10-day period.} \]
Hypothesis 1: individual investors’ “bullishness” depends on market conditions. To test this hypothesis, we need proxies for investors’ “bullishness” and market conditions. A natural proxy for investors’ “bullishness” is the level of their demand, either in absolute terms (i.e. in volume) or in relative terms (i.e. compared to the number of shares offered in the OPO fraction of the offering). Following Derrien and Womack (2001), I choose the return of industry indices in the 3-month period leading to the closing of the OPO as a proxy for market conditions.

Hypothesis 2: individual investors’ “bullishness” leads to pricing at the upper limit of the price range. This hypothesis is derived from the models: when uninformed investors are bullish, the underwriter knows that they will drive the share price up on the aftermarket, even if he chooses a high IPO price. Thus, he chooses the highest possible IPO price, i.e. the upper limit of the initial price range.

Hypothesis 3: IPOs priced at the upper limit of their price range exhibit high levels of initial return and turnover. This prediction of the models is a direct consequence of the “bullishness” hypothesis and of the pricing policy of underwriters.

4.4 Results

Hypothesis 1: the tests of this hypothesis are presented in table 2 below.

[Insert Table 2 about here.]

In panel A, I test the relation between market conditions (proxied by the industry index return in the 3-month period leading to the closing of the OPO) and individual investors’ “bullishness” (proxied by the absolute and relative levels of their demand). The 3-month market conditions variable is split into terciles. Each IPO is assigned to one of these terciles. Terciles 1, 2 and 3 can be seen as corresponding to low, intermediate and high market conditions respectively.\textsuperscript{22}

\textsuperscript{22}Taking less or more than 3 groups of market conditions does not change the results.
The first two columns of the table present the mean and median individual investors' demand in millions of Euros. The difference between groups 1 and 2 (low and intermediate market conditions) is negligible. On the contrary, there is a large difference between groups 2 and 3 (intermediate and high market conditions): 6.71 M Euros vs. 122.36 M Euros on average, 3.19 M Euros vs. 15.11 M Euros in median. These differences are statistically significant at the 5% level. In terms of oversubscription (columns 3 and 4), the same result holds: high market conditions IPOs are oversubscribed 12.15 times on average by individual investors vs. 2.24 and 2.00 times for low and intermediate market conditions IPOs respectively. These differences are statistically significant at the 5% level. Thus, individual investors' participation depends on market conditions. In other words, investors' "bullishness" can be anticipated by underwriters even in regular book-built offerings, in which individual investors do not generally submit bids.

In panel B of the table, I test the sensitivity of investor's "bullishness" to late changes in market conditions, separating the 3-month period leading to the IPO into two sub-periods: the last week leading to the IPO and the previous 2 month and 3 weeks period. The linear regressions show that both variables have a significant impact on the level of individual investors' demand: a 1% change in the industry index in the week preceding the offering leads to a mean change of 7.11 M Euros in individuals' demand. This means that even late changes in market conditions are likely to influence significantly individuals' demand (i.e. their "bullishness"). Note that the $R^2$ coefficients for these linear regressions are very large (78% and 50%), meaning that the explanatory power of market conditions on individuals' demand is very high.

In sum, the level of individuals' demand varies a lot, and is closely related to the market conditions that prevail at the time of the offering. In hot markets, the very high demand (equal to 4 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, as was hypothesized in the models.

Hypothesis 2: Tests of hypothesis 2 (the relation between individuals' demand and the IPO price chosen by underwriters) are presented in Table 3 below.
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 1 if the offering is priced at the upper bound of its price range. The result supports hypothesis 2: 17 of the 19 IPOs that fall in the low oversubscription tercile are priced below the upper bound of the price range. On the contrary, 15 of the 18 IPOs in the high-oversubscription tercile are priced at the upper bound of their price range. This shows that the impact of uninformed investors' demand on IPO pricing is very large.

Panel B of the table, which presents the levels of individuals' demand and oversubscription, shows that individuals' demand is much larger for IPOs priced at the upper bound of their price range than for other offerings (104.42 M Euros vs. 4.10 M Euros on average). When uninformed investors are bullish, IPOs are priced at the upper limit of the price range, as predicted in the models.

Let us now consider more closely the 3 offerings that were not priced at the upper bound of their price range despite a very high demand from individual investors (see Panel A, last column). These 3 IPOs share the same feature: market conditions changed abruptly at the very end of the OPO period or on the day of pricing. Consider the example of the Quali‡ow offering. In the last two days of the OPO period (the period when investors submit orders), October 6 and 9, 2000, the index of the industry to which this company belongs lost 8%. On October 10, the day of pricing, it fell by another 1%. In this case, as well as in the 2 other cases of high demand IPOs not priced at the upper limit of their price range, favorable conditions may have led to high demand by individual investors in the rst days of the OPO. But when the underwriter chose the offering price, these investors had become bearish. Hence a conservative pricing by the underwriter.

Hypothesis 3: Tests of hypothesis 3 (the link between IPO pricing and aftermarket behavior of IPO shares) are presented in Table 4 below.
The models predict that IPOs priced at the upper limit of their price range should exhibit high initial return and turnover, due to the participation of bullish uninformed investors in the aftermarket. This hypothesis is confirmed in Panel A: the mean (median) level of initial return is equal to 43.40% (18.49%) for IPOs priced at the upper bound of their range vs. 2.76% (1.52%) for other offerings. The differences between the two groups are statistically significant at the 1% level. The same observation holds for turnover.

The second version of the model predicts that IPOs can be priced at the upper bound of their price range in two distinct situations: first, when uninformed investors are bullish, and second, when they are bearish and the aggregated 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 returns should be positive, but the level of initial return should be larger on average in the “bullishness” case. Turnover should also be higher in the first case (“bullishness”) than in the second. Indeed, in the first case, uninformed investors participate in the aftermarket. In the second case, they do not participate since they are bearish, and the aftermarket price movements come only from trading by institutional investors.

This hypothesis is tested in Panel B of Table 4: IPOs priced at the upper limit of their price range are divided into two groups: those that occurred in bearish conditions (i.e. that belong to the first or second tercile of OPO oversubscription), and those that occurred in bullish conditions (i.e. that belong to the third tercile of OPO oversubscription). In the first two columns of the table, we observe that initial return is higher in mean and median in the bullish case (56.70% vs. 14.90% for the mean, 24.35% vs. 10.34% for the median), but only the mean difference is statistically significant (at a 10% level). Columns 3 and 4 show that turnover is significantly different statistically (at 1% and 5% levels for the mean and median respectively) between the two situations. This confirms that aftermarket activity is larger when uninformed investors are bullish.

In Panel C, we observe the aftermarket behavior of IPO shares for IPOs that are priced
below their price range. In the models, this pricing is chosen in bearish situations, i.e. when uninformed investors stay out of the offerings. In this situation, initial return and turnover should be very low and independent of uninformed investors’ demand. Panel C of the table presents the mean and median values of initial return and turnover depending on the tercile of OPO oversubscription for these IPOs priced below the upper bound of their price range. As predicted, we observe very low levels of both initial return and turnover, whatever tercile is considered. Note that the 3 observations in the high oversubscription tercile are the cases discussed above, with very late changes in market conditions that, despite high individuals’ demand, prevented the underwriter from pricing at the upper bound of their price range. The impact of this late change in market conditions is quite strong since these 3 offerings exhibit negative mean and median initial return.

In sum, the data confirm the predictions of the model. However, one could propose an alternative explanation to these findings: individual investors could well be bullish when institutional investors themselves are bullish. But we noted that individual investors’ demand curves are not informative (they contain mostly market orders). Moreover, this demand is highly predictable by simply looking at the return of market indices in the period leading to the offering. If supposedly informed institutional investors have the same behavior, the rather complex information extraction story told by Benveniste and Spindt (1989) to justify the use of book-building becomes useless. If they do not, the Benveniste and Spindt’s story tells us that individual investors’ demand should have a negligible impact on the pricing of IPO shares and on their aftermarket behavior, which is not the case.

5 Discussion and conclusion

The model presented in this paper considers the behavior of a group of uninformed investors: if these investors are bullish at the time of the offering, they are ready to buy IPO shares at high prices. If they are bearish they do not want to buy any shares at any price. I show that, under this framework, underwriters, who control the pricing and placement of book-built IPOs, set high IPO prices in bullish situations, and IPO prices that reflect the information provided by informed institutional investors in their coalition in bearish cases.
The main result of the paper states that book-built IPOs are overpriced (i.e. priced over their expected value per share) on average, but exhibit positive initial returns on average.

The predictions of the model are strongly supported by an empirical analysis on 56 book-built IPOs with a fraction reserved for individual investors. More precisely, individual investors’ demand varies considerably with market conditions. When their demand is high, IPOs are priced at the upper bound of their price range and exhibit high initial return and turnover.

These findings help us answer the following question: why do issuers, underwriters and institutional investors like the book-building IPO procedure? From the underwriter’s point of view, the advantages of this mechanism are twofold: first, book-building allows him to elicit information from informed institutional investors with whom they have a long-term relationship. Second, it allows them, under some conditions, to use the “bullishness” of uninformed investors to set high (and possibly overpriced) IPO prices, which guarantees high IPO fees. Besides, certain participation of the members of the underwriter’s coalition limits placement risks for the underwriter in bearish situations. For the institutional investors who belong to the underwriter’s coalition, book-building is also an interesting mechanism: first, it guarantees them to receive IPO shares that will have a positive initial return on average. Second, contrary to more market-oriented mechanisms, it limits the number of investors participating in the IPO, guaranteeing substantial allocations to investors in the underwriter’s coalition. Finally, book-building is also a good mechanism for issuers. Indeed, when this procedure is used, the placement risk is very low due to the participation of institutional investors in the underwriter’s coalition. Moreover, issuers also benefit from a potential market euphoria, which leads to high IPO prices.

Moreover, this paper sheds light on one of the most debated topics in finance: the “IPO puzzle”. On the one hand, in periods of high IPO demand, issuers can place their shares at high prices relative to their expected value, which explains the poor long-term performance of these shares in the long-run. On the other hand, the design of the dominant IPO mechanism is such that in these periods, IPO prices only reflect partially the investors’ inflated estimations, which explains the initial price run-ups following IPOs.
Bibliography


Appendix A: proof of Proposition 2

Let us start with the pricing rule chosen by the underwriter. The goal of the underwriter, who wants to maximize his fees, is to set $P_{IPO}$ as high as possible. In bullish situations, he will set $P_{IPO}$ equal to the upper bound of the initial price range, $V_H$, because the uninformed agents' behavior will lead to an aftermarket equilibrium price $P_1$ larger than this upper bound. In bearish situations, the underwriter knows that the aftermarket equilibrium price will reflect the signals of institutional investors, that is $P_1 = \frac{k+1}{I+2}V_H$. The highest IPO price available to the underwriter is then equal to $P_1$. Indeed, if he sets $P_{IPO} > P_1$, he will have to provide price support on the aftermarket in order to keep the aftermarket price equal to $P_{IPO}$. In other words, he will have to offer $P_{IPO}$ for shares that are worth $P_1$. The cost of such a strategy clearly outweighs its benefits, i.e. the additional fees provided by an increase in IPO price, whatever the level of these fees, $f$.

Next, we have to show that the allocation scheme proposed in Proposition 2 is compatible with the price $P_{IPO}$ chosen and with the incentives for institutional investors to reveal their signals truthfully.

Let us compare the costs and benefits of an investor with a positive (respectively negative) signal announcing a negative (respectively positive) signal to the underwriter.

First, consider an institutional investor with a positive signal who lies on his signal:

- if uninformed investors are bearish, his allocation is the same as if he announced his signal truthfully since $Q^+_G = Q^+_B = \frac{1}{I}$ for all $k$ in $0, \ldots, I$. But $P_{IPO}$ is set to $\frac{k}{I+2}V_H$ instead of $\frac{k+1}{I+2}V_H$. Thus, the gain from lying on his signal is equal to $\frac{1}{I+2}V_H = \frac{V_H}{I(I+2)}$.
- if uninformed investors are bullish, $P_{IPO}$ is set equal to $V_H$, and the gain per share for each investor served is equal to $P_1$ if $P_{IPO} = U$. But in this case the allocation received by the institutional investor lying on his signal is $q^+G$ instead of $q^+B$ if he had announced his signal truthfully. Thus, the institutional investor lying on his signal incurs a loss equal to $(q^+G - q^+B)U$.

From the point of view of an institutional investor with a positive signal, $k$ is a random variable that can take any value in $1, \ldots, I$. More precisely,
\[ \Pr[k = i + 1] = (|i^1\rangle(E(\mu))^i(1_i \ E(\mu))^i |i^1\rangle \text{ for all } i \text{ in } 1; \ldots; \ I_1 \ g: \]

For an investor observing a positive signal, \( E(\mu) = \frac{2}{3} \). Thus,

\[ \Pr[k = i + 1] = (|i^1\rangle(\frac{2}{3})^i(\frac{1}{3})^i |i^1\rangle \text{ for all } i \text{ in } 1; \ldots; \ I_1 \ g: \]

Consequently,

- when uninformed investors are bearish, the expected gain from lying on his signal for an institutional investor with a positive signal is: \( \frac{V_H}{1(1 + 2)} \);
- when uninformed investors are bullish, the expected loss from lying on his signal for an institutional investor with a positive signal is:

\[ U \sum_{i=0}^{i^1} (|i^1\rangle(\frac{2}{3})^i(\frac{1}{3})^i |i^1\rangle |q_{i^1+1} \ g_{i^1+1}) \]

Thus, the incentive compatibility constraint for an institutional investor with a positive signal is:

\[ pU \sum_{i=0}^{i^1} (|i^1\rangle(\frac{2}{3})^i(\frac{1}{3})^i |i^1\rangle |q_{i^1+1} \ g_{i^1+1}) \cdot \frac{V_H}{1(1 + 2)} \text{ or} \]

\[ \sum_{i=0}^{i^1} (|i^1\rangle(\frac{2}{3})^i(\frac{1}{3})^i |i^1\rangle |q_{i^1+1} \ g_{i^1+1}) \cdot \frac{(1 - p)V_H}{pU(1 + 2)} \]  \hspace{1cm} (1)

Similarly, we find that the incentive compatibility constraint for an institutional investor with a negative signal is:

\[ \sum_{i=0}^{i^1} (|i^1\rangle(\frac{2}{3})^i(\frac{1}{3})^i |i^1\rangle |q_{i^1+1} \ g_{i^1+1}) \cdot \frac{(1 - p)V_H}{pU(1 + 2)} \]  \hspace{1cm} (2)

The right parts of these inequalities are the same. The only difference between their left parts lies in the difference in \( E(\mu) \): for an institutional investor with a positive signal,
\( E(\mu) = \frac{2}{3}, \text{ while } E(\mu) = \frac{1}{3} \) when the signal observed by the investor is negative. Thus, the density function of the random variable \( k \) takes high values for values of \( k \) around \( \frac{2I}{3} \) (respectively \( \frac{1}{3} \)) for an institutional investor who observed a positive (respectively negative) signal. We will use this difference to find an allocation rule that satisfies both (1) and (2).

The idea behind this allocation rule is the following: by allocating more shares to investors announcing positive signals for large values of \( k \) (that is when the density function of the random variable \( k \) takes high values for an institutional investor who observed a positive signal, and low values for an institutional investor who observed a negative signal), we increase the left part of (1) and leave the left part of (2) almost unchanged.

Let us consider two benchmark cases. The first one consists in allocating the same number of shares to all investors in the coalition, whatever signal they announced. In this situation, \( q^+_i = 1, q^-_i = 0 \) for all \( i \) in \( \{0, \ldots, I-1\} \), and the left part of (2) is equal to 0. So (2) is satisfied but (1) is not. Indeed, allocating the same number of shares to all investors destroys the incentive to lie for investors with negative signals, since for these investors, lying on their signal would not change their allocation in bullish situations but would increase the IPO price in bearish market conditions. On the contrary, such a strategy encourages investors with positive signals to lie.

In the second benchmark case, all the shares are distributed to investors announcing positive signals in all situations. In this case, the IPO shares are divided between the \( k \) agents who announced positive signals, so that \( q^+_i = \frac{1}{i} \) and \( q^-_i = 0 \) for all \( i \) in \( \{1, \ldots, I\} \). The left part of (1) is then equal to \( \frac{3}{2I} \cdot \frac{1}{3^i} \). So (1) is satisfied if

\[
\frac{3}{2I} \cdot \sum_{i=1}^{I} \left( \frac{1}{3} \right)^i \cdot \frac{(1_i - p)V_H}{pU(1 + 2)}
\]

The left part of this inequality is increasing in \( I \) and tends to \( \frac{3}{2} \) when \( I \) tends to infinity. The right part of the inequality is decreasing in \( I \) and tends to 0 when \( I \) tends to infinity. So for any \( p \) in \( ]0; 1[ \), there exists an \( I \) above which (1) is satisfied. On the contrary, such an allocation rule does not satisfy (2) in general.
We now show that if $I$ is large enough, a strategy “mixing” the two extreme strategies presented above allows to satisfy both (1) and (2). The strategy consists of distributing all the IPO shares to investors announcing positive signals if $k$ is larger than a given number, and to give the same allocation to all investors when $k$ is smaller than this number. Let us define $k_1$ as the largest number of positive signals below which allocating all IPO shares to investors announcing positive signals allows to satisfy (1). That is, using the fact that $q^{i + 1}_a q^i_b = 0$ for all $i$ in $f 0, \ldots; k_1$, $i g$ and $q^{i + 1}_a q^i_b = \frac{1}{i + 1}$ for all $i$ in $f k_1, \ldots; I$, $i g$ and replacing in (1), $k_1$ verifies:

$$i = I - 1 X_i = k_1 (I - 1) \left( \frac{1}{3} \right)^i l_i \frac{1}{i + 1} \cdot \frac{(1 - p) V_H}{p U (I + 2)},$$

and

$$i = k_1 + 1 X_i = k_1 + 1 (I - 1) \left( \frac{1}{3} \right)^i l_i \frac{1}{i + 1} \cdot \frac{(1 - p) V_H}{p U (I + 2)}.$$  \hspace{1cm} \text{(3)}$$

If the left part of inequality (2) is smaller than the left part of inequality (3), then (2) will be satisfied. Let us show that

$$i = k_1 X_i = k_1 (I - 1) \left( \frac{1}{3} \right)^i l_i \frac{1}{i + 1} \cdot \frac{(1 - p) V_H}{p U (I + 2)} \cdot \frac{(1 - p) V_H}{p U (I + 2)}.$$  \hspace{1cm} \text{(4)}$$

Simplifying (4) yields

$$i = k_1 + 1 X_i = k_1 + 1 (I - 1) \left( \frac{1}{3} \right)^i l_i \frac{1}{i + 1} \cdot \frac{2}{3} \frac{(1 - p) V_H}{p U (I + 2)} \cdot \frac{(1 - p) V_H}{p U (I + 2)}.$$  \hspace{1cm} \text{(5)}$$

which is equivalent to

$$i = k_1 + 1 X_i = k_1 + 1 (I - 1) \left( \frac{1}{3} \right)^i l_i \frac{1}{i + 1} \cdot \frac{2}{3} \frac{(1 - p) V_H}{p U (I + 2)} \cdot \frac{(1 - p) V_H}{p U (I + 2)}.$$  \hspace{1cm} \text{(6)}$$

For a large enough $I$, $k_1 > \frac{1}{2}$. For all $i > \frac{1}{2}, 2^i l_i < 2^i$. So, for a large enough $I$, the first part of the sum on the left of the equality is negative. The second part of this sum,
\[
\left(\frac{1}{3}\right)^{i_1} \frac{1}{1 + 1} \cdot 2! \cdot i_1 \cdot k_1 \text{ is positive, but is smaller in absolute value than the rest member of the sum } \sum_{i=k_1+1}^{i_1} \frac{1}{1 + i} \cdot 2^i \cdot i_1 \cdot i \cdot 2^i \text{ for a large enough } I. \text{ Thus, for a large enough } I, \text{ (4) is satisfied. QED.}
\]

Appendix B: proof of Proposition 4

Consider rest that \( P_L \) is given. The pricing rule proposed is clearly value maximizing: the underwriter chooses an IPO price equal to the upper bound of the price range when he knows that the equilibrium aftermarket price will be higher than the upper bound of the price range (i.e. when uninformed investors are bullish or when they are bearish and the expected value per share of the company is larger than the upper bound of the price range).

When uninformed investors are bearish and the expected value per share of the company is inside the price range, he chooses a price equal to the expected value per share of the company. If he chose a higher IPO price, the cost of price support would exceed the gain in fees. Finally, when uninformed investors are bearish and the expected value per share of the company is below the price range, setting an IPO price equal to the lower bound of the price range minimizes the cost of price support.

Let us now turn to the choice of \( P_L \). If uninformed investors are bearish and \( k + k_U < k_L \), the IPO shares are overpriced relative to the aftermarket equilibrium price \( P_1 \), and the underwriter has to provide price support, that is buy at \( P_L \) shares whose expected value is equal to \( \frac{k + k_U + 1}{L + S + 2} V_H < P_L \). In this situation, the underwriter incurs a loss equal to \( \frac{k + k_U + 1}{L + S + 2} V_H \cdot P_L < 0 \).

The underwriter chooses the lower bound of the initial price range \( P_L \) so as to maximize his expected revenues, equal to his expected fees minus the expected cost of price support. These revenues are equal to:

- \( -f(P_L + \xi) \) if uninformed investors are bullish,
- \( -f(P_L + \xi) \) if uninformed investors are bearish and \( k + k_U > k_L + \xi k \),
- \( -f\left(\frac{k + k_U + 1}{L + S + 2} V_H\right) \) if uninformed investors are bearish and \( k_L \cdot k + k_U \cdot k_L + \xi k \),
- \( -f P_L + \frac{k + k_U + 1}{L + S + 2} V_H \cdot P_L \) if uninformed investors are bearish and \( k + k_U < k_L \).

In sum, the expected revenues of an underwriter who chooses \( P_L \) as the lower bound of
the initial price range are equal to:

\[
\text{pf}\left(\frac{k_L + \xi_k + 1}{1 + S + 2} V_H\right) + (1 - p) [f[A] + B];
\]  

(5)

where

\[
A = \sum_{i=0}^{\infty} \sum_{k_L} E(\mu)^i (1 - E(\mu))^i i E(\mu)^i i \left(\frac{k_L + 1}{1 + S + 2} V_H\right)
\]

and

\[
B = \sum_{i=0}^{\infty} \sum_{k_L} E(\mu)^i (1 - E(\mu))^i i \left(\frac{k_L + \xi_k + 1}{1 + S + 2} V_H\right).
\]

The three parts of sum A correspond to the expected IPO price when uninformed investors are bearish and \(k + k_U < k_L\), \(k + k_U > k_L\), and \(k + k_U > k_L + \xi_k\) respectively. B is the price support loss incurred by the underwriter if uninformed investors are bearish and \(k + k_U < k_L\). Maximizing (5) is equivalent to maximizing the following expression:

\[
\text{pf}\left(\frac{k_L + \xi_k + 1}{1 + S + 2} V_H\right) + (1 - p) [f[A_1] + B_1];
\]  

(6)

where

\[
A_1 = \sum_{i=0}^{\infty} \sum_{k_L} E(\mu)^i (1 - E(\mu))^i i (k_L + 1)
\]

and

\[
B_1 = \sum_{i=0}^{\infty} \sum_{k_L} E(\mu)^i (1 - E(\mu))^i i (k_L + \xi_k + 1).
\]

Let us show that there exists a \(k_L\) in \(f1; \ldots; I\) that maximizes (6). Let us first calculate the difference in value of expression (6) between \(k_L = 0\) and \(k_L = 1\). This difference is equal to:

\[
\text{pf} + \sum_{i=0}^{\infty} E(\mu)^i (1 - E(\mu))^i i i > 0:
\]  

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Thus, the value of expression (6) when \( k_L = 1 \) is always larger than its value when \( k_L = 0 \):

Similarly, the difference in value of expression (6) between \( k_L = 1 \) and \( k_L = 0 \) is equal to:

\[
\begin{align*}
  \text{if } i \in \{1, \ldots, k\i 1 \} & \quad E(\mu_i)(1_i - E(\mu)_i)_i + (1_i p_i) \\
  \text{if } i = 1 & \quad E(\mu_i)(1_i - E(\mu)_i)_i.
\end{align*}
\]

This expression can be positive or negative, but for small values of \( \xi_k \) and \( k_U \), its value is close to \( i pf_i (1_i - p)_i - 1_i p_i f > 0 \).

If this expression is positive, there exists a \( k_L \) in \( f1; \ldots; 1 \i \xi_k \i 1g \) that maximizes (6). If it is negative, \( k_L = 1 \).

Let us now turn to the proof that the allocation rule proposed in Proposition 4 satisfies the incentive compatibility constraints of the informed institutional investors.

Notice first that under the new hypotheses, the price range (i.e. the \( k_L \)) chosen by the underwriter reveals \( k_U \), the number of positive signals he received in the inspection phase. Thus, each institutional investor updates his \( E(\mu) \) after observing the price range. Let us consider for simplicity the case in which the underwriter receives only one positive signal (i.e. \( S = 1 \) and \( k_U = 1 \)). Thus, for an investor with a positive (respectively negative) signal, \( E(\mu) = \frac{3}{4} \) (respectively \( \frac{1}{2} \)).

We can write the incentive compatibility constraints of both types of institutional investors, as in Appendix A. For investors with a positive signal, the constraint is:

\[
\begin{align*}
  & \quad \prod_{i \in k_L} (1_i - 1)(\frac{3}{4})^i_1 (1_i + 1)_i (q_i + 1)_i (1_i + 1)_i \quad \frac{k_i + \xi_k + g_i + 1}{k_i + g_i + 2} \quad > \quad (1_i - 1)_i (1_i - 1)_i \quad \frac{1}{1(i + 2)} \\
  & \quad \text{if } i = 1 & \quad E(\mu_i)(1_i - E(\mu)_i)_i + (1_i p_i) \\
  & \quad \text{if } i = 1 & \quad E(\mu_i)(1_i - E(\mu)_i)_i.
\end{align*}
\]

For investors with a negative signal, the constraint is:

\[
\begin{align*}
  & \quad \prod_{i \in k_L} (1_i - 1)(q_i + 1)_i (1_i + 1)_i \quad \frac{k_i + \xi_k + g_i + 1}{k_i + g_i + 2} \quad 6(1_i - 1)_i (1_i - 1)_i \quad \frac{1}{1(i + 2)} \\
  & \quad \text{if } i = 1 & \quad E(\mu_i)(1_i - E(\mu)_i)_i + (1_i p_i) \\
  & \quad \text{if } i = 1 & \quad E(\mu_i)(1_i - E(\mu)_i)_i.
\end{align*}
\]

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The rest of the proof is similar to the proof that appears in appendix A.
QED.

Appendix C: example of a book-building / OPO offering: the Gi...offering in March 2000:

The characteristics of the offering, announced on March 7, 2000, were the following:
- number of shares offered: 1,612,125 (24.2% of the total number of shares)
- number of shares reserved for individual investors (OPO tranche): 241,820 (15% of the shares offered)
- price range: 21 Euros - 23.25 Euros
- choice of the IPO price: March 16, 2000
- first quotation: March 17, 2000

The orders submitted in the OPO fraction of the IPO were the following:

A orders (individual investors)

<table>
<thead>
<tr>
<th>Limit price (in Euros)</th>
<th>Number of orders</th>
<th>Number of shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.00</td>
<td>43</td>
<td>4,635</td>
</tr>
<tr>
<td>21.50</td>
<td>5</td>
<td>400</td>
</tr>
<tr>
<td>22.00</td>
<td>59</td>
<td>10,592</td>
</tr>
<tr>
<td>22.50</td>
<td>20</td>
<td>1,725</td>
</tr>
<tr>
<td>23.00</td>
<td>123</td>
<td>19,411</td>
</tr>
<tr>
<td>23.25</td>
<td>4,355</td>
<td>531,402</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4,605</strong></td>
<td><strong>568,165</strong></td>
</tr>
</tbody>
</table>

B orders (companies)
<table>
<thead>
<tr>
<th>Limit price (in Euros)</th>
<th>Number of orders</th>
<th>Number of shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21.50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22.50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23.25</td>
<td>58</td>
<td>13,151</td>
</tr>
<tr>
<td>TOTAL</td>
<td>58</td>
<td>13,151</td>
</tr>
</tbody>
</table>

Considering this order book as well as the order book obtained in the book-building fraction of the offering, the IPO price was set at 21.5 Euros.

The underwriter allocated 241,820 shares to OPO bidders. Each of the bidders who had submitted bids with limit prices at least equal to 21.5 Euros received 43% of the quantity asked for.

The stock was quoted on March 17, 2000. Its first closing price was 21.90 Euros.
• Step 1: underwriter sets price range, advertises offering through roadshow
• Step 2: investors give indications of interest (usually without price limits)
• Step 3: Underwriter sets price and allocates with complete discretion

Figure 1: the book-building procedure
Figure 2: timing of the model
I=100, p=0.5, f=7\%, \Delta k=10, E(\theta)=2/3

Figure 3: value of expression (6) depending on $k_L$
Table 1  
Descriptive statistics

The sample is 56 offerings completed on the French stock exchange between June 1999 and June 2001. 2 exchanges are considered: the Second Marché was created in 1983 to attract smaller firms. The Nouveau Marché, created in 1996, is designed for high-technology growth companies. Width of the initial price range is the width of the range, divided by the lower bound of the 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 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. This variable takes values in [0,1]. Part of the shares sold to individuals is the part of the offering that was finally offered to individual investors. Market conditions – 3 months (respectively, Market conditions – 1 week) is the return of the industry index to which the IPO company belongs, calculated using the return of this index in the 3 months (respectively, the week) preceding the closing of the book. The other variables are self-explanatory. IQR is the Inter-Quartile Range for continuous variables. Max and Min are the maximum and minimum values respectively.

<table>
<thead>
<tr>
<th>Panel A - IPO characteristics</th>
<th># of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO year</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>4</td>
</tr>
<tr>
<td>2000</td>
<td>52</td>
</tr>
<tr>
<td>2001</td>
<td>9</td>
</tr>
<tr>
<td>Exchange</td>
<td></td>
</tr>
<tr>
<td>Second Marché</td>
<td>13</td>
</tr>
<tr>
<td>Nouveau Marché</td>
<td>43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B - IPO characteristics</th>
<th>Mean</th>
<th>Median</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO size (float in M Euros)</td>
<td>33.70</td>
<td>24.84</td>
<td>28.40</td>
<td>179.79</td>
<td>5.02</td>
</tr>
<tr>
<td>Width of the initial price range</td>
<td>13.55%</td>
<td>14.29%</td>
<td>2.61%</td>
<td>16.36%</td>
<td>4.00%</td>
</tr>
<tr>
<td>OPO fraction of the offering</td>
<td>13.60%</td>
<td>10.00%</td>
<td>5.00%</td>
<td>30.00%</td>
<td>5.00%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel C - OPO outcome</th>
<th>mean</th>
<th>median</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPO total demand (A orders in M Euros)</td>
<td>43.51</td>
<td>3.63</td>
<td>13.12</td>
<td>751.60</td>
<td>0.05</td>
</tr>
<tr>
<td>Order size (A orders in Euros)</td>
<td>1.470</td>
<td>1.321</td>
<td>957</td>
<td>3.569</td>
<td>560</td>
</tr>
<tr>
<td>OPO oversubscription (A orders)</td>
<td>5.35</td>
<td>1.82</td>
<td>3.41</td>
<td>71.91</td>
<td>0.02</td>
</tr>
<tr>
<td>% of the demand at the upper limit of the range</td>
<td>92.81%</td>
<td>95.36%</td>
<td>6.31%</td>
<td>99.86%</td>
<td>58.76%</td>
</tr>
<tr>
<td>IPO price (relative to the price range)</td>
<td>52.04%</td>
<td>61.54%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Part of the shares sold to individuals (OPO)</td>
<td>14.92%</td>
<td>15.00%</td>
<td>10.25%</td>
<td>35.00%</td>
<td>0.52%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel D - IPO price</th>
<th># of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO priced at the upper limit of the range</td>
<td>22</td>
</tr>
<tr>
<td>IPO priced at the lower limit of the range</td>
<td>19</td>
</tr>
<tr>
<td>IPO priced within the limits of the range</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel E - IPO outcome</th>
<th>Mean</th>
<th>median</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market conditions – 3 months</td>
<td>1.14%</td>
<td>-9.91%</td>
<td>25.85%</td>
<td>173.68%</td>
<td>-33.39%</td>
</tr>
<tr>
<td>Market conditions – 1 week</td>
<td>-0.18%</td>
<td>-0.20%</td>
<td>6.46%</td>
<td>15.92%</td>
<td>-12.47%</td>
</tr>
<tr>
<td>1st-day initial return</td>
<td>18.73%</td>
<td>3.80%</td>
<td>20.45%</td>
<td>240.91%</td>
<td>-15.75%</td>
</tr>
<tr>
<td>1st-day turnover</td>
<td>16.73%</td>
<td>13.39%</td>
<td>19.58%</td>
<td>57.60%</td>
<td>0.29%</td>
</tr>
</tbody>
</table>
Tests of hypothesis 1: individual investors’ demand depends on market conditions

The sample is 56 offerings completed on the French stock exchange between June 1999 and June 2001 on the Nouveau Marché and Second Marché. OPO demand is the demand submitted by individual investors (A orders). 

**Oversubscription** is the OPO demand divided by the number of shares sold in the OPO fraction of the offering, as announced before the IPO. Market conditions is the return of the industry index to which the IPO company belongs. For each industry index, 3-month market conditions are split into terciles. Each IPO is assigned to one of the terciles.

Panel A presents the mean and median values of OPO demand in volume and oversubscription depending on the 3-month market condition tercile of the offering. An a (respectively, a b, a c) in superscript indicates that the values are significantly different at 1% (respectively, at 5%, at 10%) (using t tests for the means and Mann-Whitney tests for the medians) for the two groups.

Panel B presents linear regressions: the dependent variables are OPO demand in volume (first column) and oversubscription (second column). The explanatory variables are market conditions in the week leading to the OPO closing and market conditions between OPO closing date minus 3 months and OPO closing date minus 1 week. White heteroskedasticity-consistent t-statistics are in parenthesis. * (and respectively **, ***) indicates a significant factor at a 10% level (and respectively at a 5% level, at a 1% level).

### Panel A – Market conditions and OPO demand

<table>
<thead>
<tr>
<th>3-month market condition tercile</th>
<th>Total demand (in volume)</th>
<th>Oversubscription</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (in M Euros)</td>
<td>Median (in M Euros)</td>
</tr>
<tr>
<td>1</td>
<td>5.61^a</td>
<td>2.82^a</td>
</tr>
<tr>
<td>2</td>
<td>6.71^b</td>
<td>3.19^a</td>
</tr>
<tr>
<td>3</td>
<td>122.36^b,b</td>
<td>15.11^b,b</td>
</tr>
</tbody>
</table>

| # of observations | 19 | 19 | 18 |

### Panel B – Regression of OPO demand on 3-month and 1-week market condition variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Total demand (in volume)</th>
<th>Oversubscription</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market conditions (OPO-3 months to OPO-1 week)</td>
<td>243.111 (5.951)***</td>
<td>16.663 (2.704)***</td>
</tr>
<tr>
<td>Late change in market conditions (OPO-1 week to OPO)</td>
<td>710.788 (2.003)**</td>
<td>84.923 (1.937)*</td>
</tr>
<tr>
<td>Constant</td>
<td>40.829 (5.021)***</td>
<td>5.228 (4.667)***</td>
</tr>
<tr>
<td>R²</td>
<td>0.782</td>
<td>0.501</td>
</tr>
</tbody>
</table>
Table 3
Tests of hypothesis 2: high OPO demand leads to pricing at the upper limit of the price range

The sample is 56 offerings completed on the French stock exchange between June 1999 and June 2001 on the Nouveau Marché and Second Marché. OPO demand is the demand submitted by individual investors (A orders). Oversubscription is the OPO demand divided by the number of shares sold in the OPO fraction of the offering, as announced before the IPO.

In Panel A, 2 discrete variables are crossed and the number of observations in each of the category 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, 0 otherwise. Oversubscription is divided into 3 terciles (1 corresponding to low oversubscription), and each IPO is assigned to one tercile depending on its oversubscription value.

Panel B presents the mean and median values of OPO demand in volume and oversubscription depending on the Pricing at the upper limit of the price range of the offering. An a (respectively, a b, a c) in superscript indicates that the values are significantly different at 1% (respectively, at 5%, at 10%) (using t tests for the means and Mann-Whitney tests for the medians) for the two groups.

Panel A – IPO pricing and OPO demand: # of observations by oversubscription tercile for IPO priced at the upper limit of the price range (1), and other IPOs (0)

<table>
<thead>
<tr>
<th>Tercile of oversubscription</th>
<th>Pricing at the upper limit of the price range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Panel B – OPO demand for IPOs priced at the upper limit of the price range vs. other IPOs

<table>
<thead>
<tr>
<th>Pricing at the upper limit of the price range</th>
<th>Total demand (in volume)</th>
<th>Oversubscription</th>
<th># of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ( in M Euros)</td>
<td>Median ( in M Euros)</td>
<td>Mean</td>
</tr>
<tr>
<td>0</td>
<td>4.10^a</td>
<td>2.32^a</td>
<td>1.44^a</td>
</tr>
<tr>
<td>1</td>
<td>104.42^a</td>
<td>18.75^a</td>
<td>11.38^a</td>
</tr>
</tbody>
</table>
Table 4
Tests of hypothesis 3: IPOs priced at the upper limit of their price range exhibit high levels of initial return and turnover

The sample is 56 offerings completed on the French stock exchange between June 1999 and June 2001 on the Nouveau Marché and Second Marché.

Panel A presents the mean and median values of 1\textsuperscript{st}-day initial return and turnover depending on the Pricing at the upper limit of the price range of the offering. An a (respectively, a b, a c) in superscript indicates that the values are significantly different at 1% (respectively, at 5%, at 10%) (using t tests for the means and Mann-Whitney tests for the medians) for the two groups.

Panel B presents the same statistics for IPOs that are priced at the upper bound of the price range, depending on whether OPO oversubscription was strong (1\textsuperscript{st} tercile) or weak (2\textsuperscript{nd} or 3\textsuperscript{rd} tercile).

Panel C presents the same statistics for IPOs that are priced below the upper bound of the price range, depending on their tercile of OPO oversubscription.

Panel A – 1\textsuperscript{st}-day initial return and turnover for IPOs priced at the upper limit of the price range vs. other IPOs

<table>
<thead>
<tr>
<th>Pricing at the upper limit of the price range</th>
<th>Initial return</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>0</td>
<td>2.76%\textsuperscript{a}</td>
<td>1.52%\textsuperscript{a}</td>
</tr>
<tr>
<td>1</td>
<td>43.40%\textsuperscript{a}</td>
<td>18.49%\textsuperscript{a}</td>
</tr>
<tr>
<td># of observations</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

Panel B – 1\textsuperscript{st}-day initial return and turnover for IPOs priced at the upper limit of the price range after strong OPO oversubscription vs. weak OPO oversubscription

<table>
<thead>
<tr>
<th>Strong oversubscription (3\textsuperscript{rd} tercile)</th>
<th>Initial return</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>0</td>
<td>14.90%\textsuperscript{c}</td>
<td>10.34%</td>
</tr>
<tr>
<td>1</td>
<td>56.70%\textsuperscript{c}</td>
<td>24.35%</td>
</tr>
<tr>
<td># of observations</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Panel C – 1\textsuperscript{st}-day initial return and turnover for IPOs priced below the upper limit of the price range, depending on the level of OPO oversubscription

<table>
<thead>
<tr>
<th>Tercile of oversubscription</th>
<th>Initial return</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>1</td>
<td>3.88%</td>
<td>2.42%</td>
</tr>
<tr>
<td>2</td>
<td>3.42%</td>
<td>1.20%</td>
</tr>
<tr>
<td>3</td>
<td>-6.64%</td>
<td>-6.74%</td>
</tr>
<tr>
<td># of observations</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>