Why are European IPOs so rarely priced outside the indicative price range?*

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Abstract

In contrast to practice in the U.S., European IPOs are very rarely priced outside the indicative price range, and frequently are priced at its upper bound. We develop a model that provides a rationale for this seemingly inefficient pricing behavior. The model allows for the practice, observed in Europe but not in the U.S., whereby underwriters obtain information from investors *prior to* establishing the indicative price range. With this alternative staging of the information game, first studied by Benveniste and Spindt (1989), a commitment to not exceeding the upper bound is necessary to extract private information from investors. The model has important implications for empirical research based on European primary market data.

1. Introduction

In the last decade, the use of bookbuilding as a means of conducting securities offerings has spread from the United States to most other major countries. In the case of equity initial public offerings (IPOs) bookbuilding is now used in over four-fifths of all non-U.S. offerings (Ljungqvist, Jenkinson and Wilhelm, 2003). Whilst in many respects bookbuilding procedures for IPOs are similar across countries, there are some important differences. This paper focuses on one particular distinction between U.S. and European practice regarding IPOs: how the ability of investment banks in European IPOs to elicit information from investors prior to setting an initial indicative price range changes the nature of the information revelation problem facing the investment banking syndicate. Our theoretical model offers an explanation for a striking empirical discrepancy between U.S. and European IPOs: the relatively infrequent pricing of European IPOs outside the initial indicative price range.

In the U.S., communications with investors are guided by the 1933 Securities Act. The Act requires that investors receive financial and other significant information concerning securities being

offered for public sale and prohibits deceit, misrepresentations, and other fraud in the sale of securities. Section 5 of the Act prohibits any "offer" prior to the filing of a registration statement, and also prohibits any sale (or any contract to sell) prior to the registration statement becoming effective.[1] Banks' legal advisors interpret the U.S. regulatory framework as discouraging contact with investors prior to the registration period beyond circulation of a "pink herring", which contains little more than basic factual information and announces that the company concerned is considering an offer.

Investors in U.S. offerings are only asked to reveal their views about the IPO during the book-building phase, which starts with the announcement of an initial indicative price range, and involves road-show presentations, one-on-one meetings with selected investors, and via direct marketing by members of the investment banking syndicate. As noted by Bradley, Jordan and Ritter (2003), during the registration period, and for 25 days after the IPO (the "quiet period"), the company and their advisors are able to present statements of fact, but are not allowed to publish any opinions regarding the valuation of the company. Research analysts associated with members of the investment banking syndicate are important in providing post-IPO coverage, but do not produce their first reports until the end of the quiet period. During the bookbuilding bids are submitted to the bookrunner who constructs a demand curve for the issue. If demand is strong the initial price range can be revised. Within this institutional context Benveniste and Spindt (1989) first analysed how investment banks can provide investors with incentives to produce and reveal information regarding the value of the firm.

Within Europe the exchange of information between investors and the investment banking syndicate can occur earlier, before the initial price range is set. This reflects less strict *interpretation* of securities laws within Europe[2], as there are few formal regulations that prescribe the details of how an offer should be conducted. The research analysts associated with the investment banking syndicate routinely produce written research reports prior to the offering's registration. Draft reports are typically vetted by the lead manager(s) to ensure "consistency" before being distributed by syndicate members to potential investors. Usually, the research reports do not include a price

[1] Rule 430A permits a registration statment becoming effective without an indicative price range which can then be included in the final prospectus.

[2] Although regulations vary from country to country, bankers for European offerings apparently defer to what they perceive as the more demanding constraints imposed by authorities in London. In any event, the pre-marketing practices we describe occur throughout Europe and for the purpose at hand it is unneccessary to draw fine distinctions between individual European markets.

range as such, but often give an indication of the valuation range that the analyst believes is reasonable. Key investors are offered meetings with the syndicate's analysts to discuss the offer. Subsequently, they are asked for feedback regarding the price at which they would subscribe. The formality of the process varies considerably across IPOs. At its most formal, investment banks request responses to extensive questionnaires that survey the investor's investment strategy and holdings as well as its reaction to the company and its thoughts on valuation. The information gathered during this pre-marketing phase can then be taken into account in setting the initial indicative price range. Conditional upon the price range, the investors can submit formal bids.

Although these difference in practice are driven by alternative interpretations of securities law in the U.S. and Europe, they nonetheless constrain the conduct of IPOs. We can find no evidence that U.S. offerings are subject to the formal efforts to disseminate and collect information prior to registration that are routine in Europe. Furthermore, one of the complexities associated with targeting investors in both the U.S. and Europe is the need to observe the different sets of rules. We know of one case where a syndicate member inadvertently distributed research intended for European investors by email to U.S. investors during the pre-marketing phase and was promptly thrown out of the IPO syndicate.

The ability of the investment bank to canvass the opinion of investors in Europe prior to setting the initial price range adds complexity to the information revelation problem facing the syndicate. In this paper we present a model based upon these European conventions, in which the investment bank asks particular ("informed") investors for their views on the value of the IPO prior to setting the initial price range. Knowing that positive feedback drives up the offer price, investors have an incentive to understate their beliefs. But this incentive distortion can be resolved by simultaneously committing to not exceed the indicative price range regardless of feedback during the bookbuilding effort and to favor all other ("uninformed") investors in the event of oversubscription. The result depends on a positive probability that private information will be exogenously revealed to uninformed investors prior to the offering being completed. With this threat, and a firm commitment to the upper bound of the indicative price range, informed investors run the risk of being crowded out at the offering if they understate their beliefs in communications on which the investment bank conditions the indicative price range. We show that, in equilibrium, this mechanism induces information production and truthful revelation.

Although we do not provide a formal test of our model, we show how this alternative staging

of the information game may help to explain one of the main discrepancies observed between U.S. and European IPOs. In the U.S., the final price is frequently set outside the initial price range, whereas in Europe the final price is usually within the initial price range, and very frequently at the boundaries of the price range (we present evidence on this in the next section). In our model this stickiness of the initial price range is not inefficient or the result of institutional rules. It is an essential component of the mechanism for inducing information revelation. Furthermore, our model may help to explain the lack of price-limited bids ("limit bids") observed by Jenkinson and Jones (2002) in their analysis of European IPOs. In our model, informed investors do not reveal information via limit bids[3] during the bookbuilding phase, but rather reveal their information earlier and then submit strike bids.

The remainder of the paper proceeds as follows. In the next section we discuss the institutional setting in more detail and present evidence on the conduct of IPOs in Europe. In section 3 we present the theoretical model. Conclusions and a discussion of the implications of the alternative staging of the information game for empirical analyses of European data are contained in section 4.

2. The Institutional Setting

In many respects the spread of bookbuilding to countries outside the U.S. has resulted in greater similarity in IPO procedures. This is particularly true of the bookbuilding period itself, during which key executives of the issuing company make presentations to potential investors, the investment banking syndicate markets the issue, and orders are entered into the industry-standard bookbuilding software. However, the fact that IPOs where the target market includes more than one country are often structured into a number of separate selling syndicates indicates that there are important differences in the way IPOs are conducted. The most important distinction relates to the interaction between investors and the investment bank prior to the bookbuilding phase; we refer to this as the pre-marketing period.

To illustrate the issues, we will use the example of a recent large European privatisation. The IPO involved about forty investment banks, and four separate placement syndicates were formed. These syndicates had exclusive selling rights for their respective geographical areas, which were (1)

[3] Limit bids are more informative than non-price limited bids for a particular quantity. The latter are referred to as strike bids as they are priced at the final strike price.

the country of origin of the issuer (2) U.S. (3) Japan and (4) rest of the world. Separate placement syndicates were created for Japan and the U.S. explicitly because the distribution of research during the pre-marketing period is prohibited in these countries.[4] In Europe and the rest of Asia, (excluding Japan) no such prohibition exists. Hence, Canada, which does allow the distribution of pre-IPO research, was included in the rest of the world syndicate rather than alongside the U.S. Research reports, including forecasts of future earnings, were then distributed to institutional investors in the home country and rest of the world syndicates. These investors were then asked to fill out a detailed feedback form which asked for information about the investor (e.g. whether they were index-trackers, asset allocators, or stock pickers), their total assets under management and current weighting in the sector and country, their perceptions of the firm going public, whether they would attend the road-show or wanted a one-on-one meeting, their views on the appropriate share price and what they considered the key valuation ratio, and finally whether they were likely to invest and, if so, how much.

Whilst the formality of the information gathering during the pre-marketing varies considerably across IPOs, the important distinction is that there is a considerably greater opportunity to exchange information, and so the information revelation problem involves giving incentives to investors to become informed and to reveal valuable information that can be fed into the initial price range.

This is not to say that there is *no* contact between U.S. investors and the selling syndicate before the bookbuilding period. In some cases (particularly those, as in the example given earlier which involve non-U.S. companies making offers in the U.S.) a pink herring is issued, which describes the company but contains little information that would inform a valuation exercise. The pink herring allows analysts to present the company - but not the offering - to investors before the bookbuilding starts. Whilst some useful information regarding investors' perceptions of the company may result from this interaction, analysts are seriously constrained by the strict requirement not to "condition the market" prior to a formal offering. Furthermore, there is simply much less information available to U.S. investors during the pre-marketing period upon which to base an opinion of the appropriate price.

There are, of course, some differences in the regulations observed in different countries. For

[4] The syndicates for Japan and the U.S. were not combined, it appears, because of a desire to ensure some selling effort to Japanese investors. It was feared that a combined syndicate would result in most selling efforts being directed to U.S. investors.

example, the German stock exchange introduced a new code of conduct for IPOs in September 2002 that prohibits syndicate banks from releasing research to investors in the two weeks prior to the offering. However, to comply with this regulation, research notes simply have to be produced before the two week blackout period. Furthermore, non-syndicate banks face no such restrictions, and will normally be supplied with the same detailed financial information upon which to base their research.[5]

Given these differences in the timing of information, one obvious question is: are initial price ranges more accurate outside US, and how do final offer prices relate to the initial price range? Table I provides a detailed summary of the pricing behavior for the ten most active European markets during the January 1992 - July 1999 period, along with equivalent evidence for the U.S.[6]

Consider first the width of the initial price ranges. If less information is available in setting the initial price range in the U.S. then it might be expected that the chosen range would be wider. In fact, as Table I shows, this is not the case. The width of the initial price range is remarkably similar across countries. Furthermore, in the U.S. the tendency is to set a price range of exactly $2, with most issuers attempting to engineer (for example, via stock splits) an initial price range in the $10-$20 range. Less established issuers tend to have lower issue prices, but the same $2 range, and therefore have higher proportionate width. Hence, in the U.S., the width of the price range tends to be governed by convention, rather than related to intrinsic uncertainty. Outside the U.S. no such conventions exist, but the average price ranges are rather similar. However, these differences make it difficult to draw any implications from a comparison of the width of initial price ranges.

Furthermore, although it may be a convention in the U.S. to set an initial range with a $2 width, the fact that the range can be revised reduces the significance of the initial range. As can be seen in Table I, in nearly one-half of all U.S. IPOs the final offer price is set outside the initial price range, with roughly equal numbers set above and below. In contrast, across the whole European sample,

[5] Lead managers often go to some lengths to influence the content of research notes produced by non-syndicate analysts. In the 2001 IPO of mobile phone company Orange (which was being floated by its parent France Telecom), independent analysts were asked to agree to the same restrictions on their research as those analysts working for banks in the IPO syndicate, as a condition of being able to attend a briefing session on the company. In addition - in return for access to detailed information regarding Orange - the global co-ordinators were granted "absolute discretion to decide whether to comment on the content of a draft research report or to amend or correct anything with which they may disagree". The Financial Times (20 Dec, 2000) reported that 160 analysts attended this briefing, which lasted 9 hours, and that the Association of British Insurers – representing institutional investors – had written to the lead managers objecting to the restrictions, which prevented the publication of any research for 40 days around the time of the issue and disallowed recommendations to buy or sell shares. However, such (blatent) attempts to influence the content of independent research are rare.

[6] We are very grateful to Alexander Ljungqvist who prepared this data for us.

the final price was set outside the initial price range in just over 11 percent of IPOs. Furthermore, the final price was set strictly at the high end of the initial range in nearly 44 percent of European IPOs, compared with less than 13 percent of U.S. IPOs.

Why are European offer prices apparently constrained by the initial price range? In general, regulations that bear on price range revisions appear no more onerous in Europe than in the U.S. Revisions always necessitate re-contacting investors to check whether they are still prepared to bid within the new price range, at least when the revision is upwards.[7] This is more work for the investment bankers, but this could probably be achieved in a couple of days. Furthermore, price range revisions typically require new filings with the relevant regulators. Consequently, if the decision to revise is taken near the end of the original bookbuilding period, the offer may be delayed a few days.

Specific regulations governing revisions differ somewhat between countries. In the U.S. if the initial price range is revised by no more than 20% then the procedures are relatively straightforward. Larger revisions require a re-filing which involves more work and costs. As far as we are aware, no such restrictions on the size of revision exist in Europe. The fact that in all European countries there are examples of pricing outside the initial range indicates that this is possible, although there is some debate regarding the procedures in Germany. As Table I shows, of the 219 German IPOs sold using bookbuilding methods none were priced above the top of the indicative price and 157 (71.7 per cent) were priced at the upper bound. Löffler, Panther and Theissen (2002) suggest that prospectuses have only recently allowed for upward adjustment of the bookbuilding range in response to overall market or specific demand conditions. Furthermore, Aussenegg, Pichler and Stomper (2002) note that strike bids were legally binding on the (now defunct) Neuer Markt within the initial price range (most of the German IPOs in Table I were on the Neuer Markt). They further claim that investment banks were concerned about possible legal action resulting from setting the offer price outside the initial range. These idiosyncratic features of the German IPO market[8] may have resulted in *de facto* restrictions on pricing above the initial price range. However, we know

[7] In fact, there are examples where investors were asked to re-confirm their bids even when the price range was reduced. In the case of the IPO of mobile phone company Orange, mentioned in footnote 5, the IPO price range was revised downwards, and both institutional investors (who had bid in the bookbuilding) and retail investors - who had submitted quantity bids on the basis of a discount to the price set in the institutional bookbuilding - were given the chance to retract their bids, even though the final price was unambiguously *lower* than investors had expected to pay.

[8] A further unusual feature of the German IPO market is the existence of an active grey market. Löffler et al. (2002) analyse this market and find grey market "when issued" prices are informative about subsequent trading prices.

of no other such restrictions outside Germany, and yet pricing outside the initial price range is consistently less common.

In the context of the U.S. institutional arrangements, various authors have extended the Benveniste and Spindt model to explain how optimal mechanisms for extracting private information from investors requires discriminatory share allocation and a partial adjustment to positive news from investors (Benveniste and Wilhelm, 1990; Hanley, 1993; Sherman and Titman, 2002). Consistent with the theory, U.S. IPOs commonly are priced above the upper bound of the indicative price range but still exhibit large first-day returns. Given that price ranges are much less frequently revised outside the U.S., does average underpricing differ significantly?

In Table I we measure underpricing in two ways: relative to the mid-point of the initial price range, and relative to the final issue price. The former gives a measure of the accuracy of the initial price range. Clearly, if the initial price range is very sticky in Europe, then it is particularly important that it is accurate. The second measure of underpricing measures provides a measure of how much money is "left on the table."

For the sample as a whole, European underpricing is, on average, 2-3 percentage points higher than in the U.S., on either of our measures. In contrast to our earlier discussion, this evidence would tend to suggest that initial price ranges are based on less information in Europe than in the U.S. However, it is noticeable that Germany is very much an outlier in respect of underpricing (and may also, as discussed earlier, be subject to slightly different regulatory constraints). If Germany is excluded from the European sample the average underpricing relative to the initial price range falls to 15.5% - significantly lower than the 23% observed in the U.S.- and average underpricing relative to the issue price falls to 12.4% in Europe, compared with 18.3% in the U.S.

Of course, these are simple averages and do not allow for any compositional effects in the samples of IPOs, nor for timing differences (given that we know that IPO returns are subject to *hot issue* periods), nor for the various factors that might influence the accuracy of IPO pricing (on this see Ljungqvist, Jenkinson and Wilhelm, 2003). Viewed through a U.S. institutional lens, the (*de facto*) binding nature of the initial price range appears inefficient. However, the stylised evidence suggests that, for most European countries, initial price ranges are more accurate, and that less money is left on the table. In the next section we present a theoretical model that provides an explanation for the stickiness of initial price ranges, based upon the assumption - which we have argued is consistent with practice in most countries outside the U.S. - that investors can become

informed and reveal information to the investment banking syndicate in the pre-marketing phase. In the model the (implicit) commitment not to set the price outside the initial price range plays an essential role in incentivising information production.

3. The Model

We consider a simple model in which an investment bank wishes to sell $\$S$ of a share whose fair price $\tilde{P}$ is P_h or $P_l = P_h - \Delta P < P_h$, with respective *ex ante* probabilities π_h and π_l, where $\pi_l + \pi_h = 1$. There is a universe of $I+1$ potential risk neutral investors in the share, each of whom is endowed with \$1. We assume that

$$I > S,$$

so that equilibrium share rationing is possible.

Investor 0 is endowed with an information technology which, in return for an initial investment of $\$c$, returns a perfect signal of $\tilde{P}$. Whether or not investor 0 has used her information technology is unobservable.[9] Investors $1, 2, \ldots, I$ have no information technology but with probability $\lambda < 1$ they all learn the security's value. We refer to these investors as "uninformed". The investment bank's objective is to design a mechanism to induce investor 0 to use her information technology and to reveal her information so that it can be incorporated into an indicative price p.

The mechanism is staged as follows:

t_0 The bank asks investor 0 to report a price p for the share and to bid for the share;

t_1 The bank quotes a price range $[p - d_p, p]$ for the share and asks the remaining I investors to bid for the share;

t_2 With probability λ, the remaining investors learn $\tilde{P}$;

t_3 Investors decide whether to bid for the share and provide the bank with a quantity bid Q, which is good throughout the region $[p - d_p, p]$;

t_4 The bank allocates shares to bidders. If there is excess demand for the issue then the bank exercises discretion in determining allocations.

Note that the bank's quoted discount d_p is dependent upon p.

[9] Sherman and Titman (2002) examine a model in which several traders have access to a costly information production technology. In our model we assume for simplicity that only one informed trader participates in the initial bookbuilding stage. Relaxing this assumption would not materially affect our results.

This staging of events corresponds with the institutional setting described in the preceding section. At t_0 the bank approaches key investors whose input is sought before establishing the indicative price range. Periods t_1 to t_3 correspond to the traditional staging of a bookbuilding effort. We search for equilibria in which the uninformed investors follow symmetric strategies. In doing so, we assume that the bank is able to commit at time t_0 to the following strategy:

1. To make no *ex post* adjustments to the range $[p - d_p, p]$ quoted at time t_1;
2. To provide allocational preference in oversubscribed issues to uninformed traders;
3. To allocate all of the shares in oversubscribed issues at the top of the time t_1 range (p) and in other issues at the bottom of the range ($p - d_p$);
4. To cancel the share issue if $p \notin \{P_l, P_h\}$.

The first assumption reflects the empirical fact we seek to rationalize. Coupled with the second assumption, it provides the mechanism for penalising informed traders who fail to gather or misstate information. It is difficult to provide systematic evidence to support the assumption that uninformed investors are treated favourably in the event of oversubscription. However, there is considerable anecdotal evidence to suggest this is a reasonable assumption. A significant proportion of the "uninformed" are likely to be individual ("retail") investors. There are many examples of retail investors being favoured in allocation. For example, in the 2002 IPO of UK bookmakers William Hill, the final book was ten times subscribed. Retail investors had submitted just under 2% of the £6.2bn of bids, yet were allocated 14% of the final offering. Similarly, in many countries that combine an institutional bookbuilding with a public offering[10], it is quite common for there to be clawback arrangements, whereby if (total) demand is unexpectedly strong the size of the public offering is increased at the expense of the institutional bookbuilding. In general, when feedback is weak, lead managers also encourage syndicate members to broaden the retail network by pitching the deal more widely among retail brokers. But these brokers would have little incentive to exert effort on behalf of the syndicate if they expected their clients to be excluded from hot issues.

The third assumption ensures that uninformed traders oversubscribe only when they learn that the informed investor has reported an incorrect price, while guaranteeing the informed investor a payment d_p for truthful reporting. Of course, observed prices often are set within the bookbuilding

[10]The public offering often takes place a few days after the end of the bookbuilding, which allows the public offer price to be set equal to (or at a modest discount to) the price established during bookbuilding.

range. In a more complex model one could accomplish this by endowing uninformed investors with noisy and uncorrelated signals of the issuer's type. In equilibrium, the quality of the uninformed investors' audit would be an increasing function of their aggregate demand, as would the issue price. This generalization would only obscure our essential point with additional complexity.

The fourth assumption is designed to avoid off the equilibrium path outcomes: it will never be invoked. Although it is not time-consistent we assume that reputational considerations provide enforcement.

In equilibrium these commitments induce uninformed investors to bid for \$1 of the share if they learn (with probability λ) that $p < \tilde{P}$. If they learn that $p = \tilde{P}$ and investor 0 has bid for $\$(1-c)$ of the share then they will each bid for

$$Q_{NR} \equiv \frac{S-1+c}{I}$$

shares. This is the highest quantity which avoids rationing and so ensures an issue price of $\tilde{P} - d_{\tilde{P}}$ and hence yields a profit. Higher quantities result in rationing and hence by commitment (3) an issue price of $\tilde{P}$ and investor profit of \$0.

Now assume that investor 0 has used her information technology and so knows the realisation of $\tilde{P}$. The bank selects d_h and d_l to induce truthful reporting.[11] It is obvious that the low state will always be reported truthfully[12]. Assume for the moment that uninformed traders will never bid for more than Q_{NR} shares in the absence of a time t_2 signal: we demonstrate below that this assumption is correct in equilibrium. The truth-telling constraint in the high state is then:

$$d_h \geq (d_l + \Delta P)(1-\lambda), \qquad (TT)$$

where the multiplier $(1-\lambda)$ indicates that under reporting is discovered with probability λ. In this case the informed investor makes no profit from the IPO (since $I > S$ and uninformed investors receive allocation priority). Constraint TT shows that the informed investor requires an incentive to reveal private information.[13]

[11] With a harmless abuse of notation, we write d_h for d_{P_h} and d_l for d_{P_l}.

[12] Sherman and Titman (2002) consider a model in which the informed trader's information technology is imperfect. In this case the issue may be more accurately priced if more than one informed trader is asked to participate. With severe high state underpricing, the low state may not be reported truthfully if overstatement of quality yields preferential allocations. This places an upper bound upon IPO underpricing which does not arise in our model.

[13] Unlike previous work (see Benveniste and Spindt, 1989, Benveniste and Wilhelm, 1990 and Sherman and Titman, 2001), it need not follow that hot issues (those for which the fair price is revealed to be in the high state) are more heavily discounted than cold issues. We examine below the equilibrium conditions for this to be the case.

The informed investor must also be induced to undertake costly information production, rather than making an uninformed report. If the truth-telling constraint TT is satisfied, this requirement yields an incentive-compatibility constraint for each of the uninformed reports available to the informed investor:

$$\begin{aligned} \pi_h d_h + \pi_l d_l - c &\geq \pi_h (d_l + \Delta P)(1-\lambda) + \pi_l d_l, \\ \text{or } d_h &\geq \frac{c}{\pi_h} + (d_l + \Delta P)(1-\lambda). \qquad (IC_l) \\ \text{and } \pi_h d_h + \pi_l d_l - c &\geq \pi_h d_h - \pi_l (\Delta P - d_h), \\ \text{or } d_h &\leq (d_l + \Delta P) - \frac{c}{\pi_l}. \qquad (IC_h) \end{aligned}$$

IC_l assumes that uninformed investors will crowd out trader 0 if they discover that the issue is underpriced. Later, we derive conditions which ensure that this occurs. IC_l implies TT, so the truth-telling constraint cannot bind. This occurs in our model because passively reporting the low state yields a combination of the returns from dishonest high state reporting and low state honesty. Information production can therefore only be incentivised if the high state discount is sufficient to compensate trader 0 for both her honesty *and* her information costs.[14] Finally, observe that IC_l implies that $\pi_h d_h + \pi_l d_l > c$ and hence that investor 0's participation constraint is automatically satisfied whenever the incentive-compatibility constraints are satisfied.

The constraints TT and IC were derived assuming that uninformed investors bid only for Q_{NR} shares in the absence of a time t_2 signal and thereby enable investor 0 to invest his entire wealth net of information costs in the offering. This will be the case provided

$$d_h,\, d_l \geq 0. \qquad (Pos)$$

When investor 0 is proved (with probability λ) by a time t_2 signal to have reported an untruthful low price, commitment (2) implies that uninformed investors can crowd him out by bidding \$1 each in the offering. They will elect to do so when

$$\begin{aligned} Q_{NR}(d_l + \Delta P) &\leq \frac{S}{I}\Delta P, \\ \text{or } d_l &\leq \frac{\Delta P (1-c)}{S - 1 + c} \qquad (CO) \end{aligned}$$

We have therefore proved the following:

[14] Sherman and Titman (2002) obtain a similar result in a model which has both endogenous information accquisition and strategic interaction between multiple informed traders.

PROPOSITION 1 *When the investment bank commits to rules 1, 2,3 and 4 above and sets d_h and d_l to satisfy TT, IC, Pos and CO, it is an equilibrium for investor 0 to use his information technology and to quote the true price, and for uninformed investors to bid for Q_{NR} shares.*

Proposition 1 provides a rationale for the apparent unwillingness of banks to set offer prices above the indicative price range for European IPOs. A firm commitment to the indicative price range produces oversubscription when informed investors understate their information and uninformed investors become informed exogenously. The bank responds to oversubscription by favoring uninformed investors with share allocations. The threat that uninformed investors will become informed exogenously and crowd out informed investors thereby disciplines informed investors ensuring that they use their information technology and provide a truthful report of its output. Thus uninformed investors function similarly to the speculative monitors of Aghion, Bolton and Tirole (2000). Although the bank's optimal *ex post* response to overbidding would be to raise the price range, if uninformed investors anticipated this they would never oversubscribe a new issue. Thus the disciplining role of uninformed investors would be lost, and informed investors would not quote $\tilde{P}$ at time t_0. The bank's commitment never to adjust the price range is therefore central to our conclusions.

We now determine the investment bank's optimal policy. The bank's objective is to minimise the expected level of underpricing

$$\pi_l d_l + \pi_h d_h,$$

subject to TT, IC_l, IC_h, and Pos. Recall that TT is implied by IC_l. Figure 1 illustrates constraints IC_l, IC_h and CO in (d_l, d_h) space, and also shows two iso-underprice lines: constraint Pos limits policies to the positive quadrant. The feasible contract region is shaded. The intersection between IC_l and IC_h occurs at

$$d_l^* \equiv \frac{c\left(\pi_l + \pi_h\right)}{\lambda \pi_l \pi_h} - \Delta P.$$

Note that there are no feasible contracts if this expression exceeds $\frac{\Delta p(1-c)}{S-1+c}$: equivalently, if

$$\lambda < \lambda^{NC} \equiv \frac{c}{\Delta P} \frac{\pi_l + \pi_h}{\pi_l \pi_h} \frac{S-1+c}{S}. \qquad (NoContract)$$

When $\lambda \geq \lambda^{NC}$ it is clear from inspection of the iso-underprice lines in figure 1 that the optimal contract lies at the left-most point in the feasible contract region. This will be $\left(0, \frac{c}{\pi_h} + \Delta P\left(1-\lambda\right)\right)$

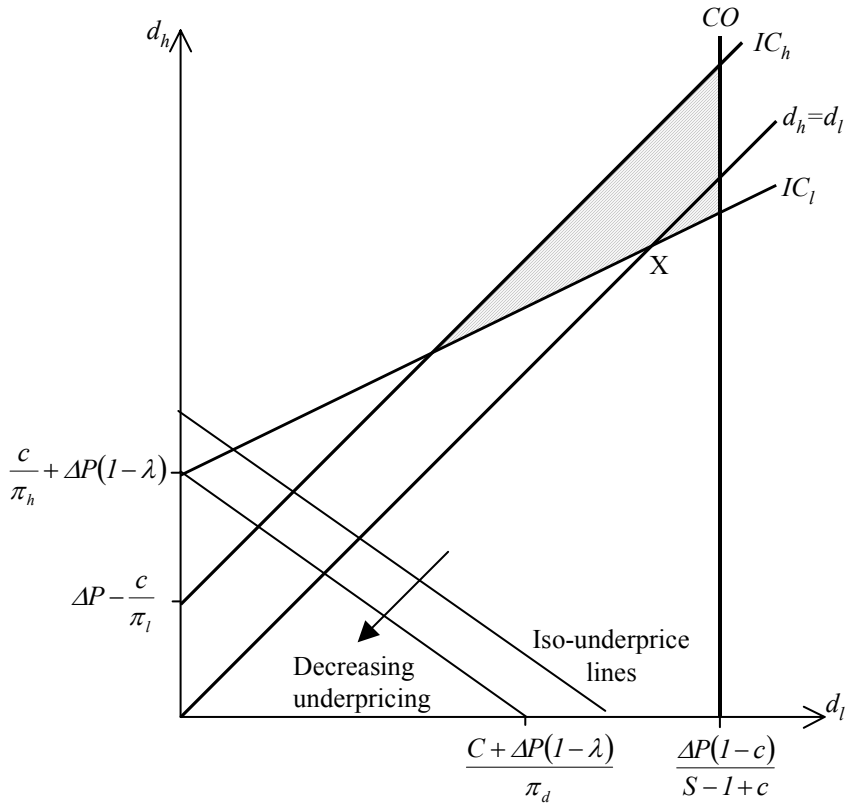

Figure 1: The feasible contract region.

if $d_l^* \leq 0$: equivalently if

$$\lambda \geq \lambda^{l0} \equiv \frac{c}{\Delta P}\frac{\pi_l + \pi_h}{\pi_l \pi_h}. \qquad (HotMktDiscount)$$

In this case, discounts occur only in hot markets where the fair price is revealed to be in the high state. Figure 1 illustrates the situation for interim λ values ($\lambda^{NC} \leq \lambda < \lambda^{l0}$), when the optimal contract lies at the intersection of IC_l and IC_h: $\left(d_l^*, d_l^* + \Delta P - \frac{c}{\pi_l}\right) = \left(\frac{c(\pi_l+\pi_h)}{\lambda\pi_l\pi_h} - \Delta P, \frac{c(\pi_l+\pi_h(1-\lambda))}{\lambda\pi_l\pi_h}\right)$ and discounts can be positive in either hot or cold markets.

We summarise our discussion of optimal investment bank contracts in proposition 2.

Proposition 2 *Underpricing levels (d_l, d_h) in the optimal bookbuilding contract with a single stage investor and a fixed initial price range depend upon the probability λ of exogenous learning in the following way:*

1. *If $\lambda < \lambda^{NC}$ then no contract achieves truthful reporting by informed investors;*

2. *If* $\lambda^{NC} \leq \lambda < \lambda^{l0}$ *then*

$$(d_l, d_h) = \left(\frac{c(\pi_l + \pi_h)}{\lambda \pi_l \pi_h} - \Delta P, \frac{c(\pi_l + \pi_h(1-\lambda))}{\lambda \pi_l \pi_h} \right);$$

3. *If* $\lambda \geq \lambda^{l0}$ *then*

$$(d_l, d_h) = \left(0, \frac{c}{\pi_h} + \Delta P(1-\lambda) \right).$$

λ^{NC} *and* λ^{l0} *are defined in equations* NoContract *and* HotMktDiscount *respectively. Moreover, the expected level of underpricing is decreasing in* λ.

Proof. Only the comparative static of the expected level of underpricing is not already proven. This follows trivially from the expressions in the statement of the proposition. □

Exogenous learning by uninformed investors provides a means by which under reporting can be penalised. Proposition 2 demonstrates that this is essential for our conclusions. When the probability λ of learning is sufficiently low under-reporting goes unpunished and it is impossible to incentivise information production (and hence revelation, since IC_l implies TT). When an optimal bookbuilding contract exists, the expected level of underpricing is decreasing in λ (in other words, in the severity of the penalty for misreporting), and the extent of underpricing is also decreasing, in that only hot issues are underpriced for sufficiently high λ. Note that the minimum expected level of underpricing (when $\lambda = 1$) is c. In other words, when the informed trader will certainly be penalised for misrepresentation, he need only be compensated for his costs of information production.

To understand condition 1, note that a feasible contract exists only if the benefit which uninformed investors derive from increased share allocations when they whistle-blow on t_0 under-reporting exceeds that derived from saying nothing and sharing in the returns on misinformation (constraint CO). This observation is captured by the last term $\frac{S-1+c}{S}$ in equation *NoContract*. If this term is large, then the increased allocations from crowding out informed investors are insufficient to incentivise truthful reporting. In a simple extension of the model the investment banker could resolve the problem by inviting several informed traders to participate in the information acquisition stage (time t_0) and thus reduce the allocations received by uninformed traders if they do not crowd out the informed investors.

Conditions 2 and 3 respectively describe the circumstances where all issues are underpriced, and where only hot (high state) issues are underpriced. To understand them, we must think about trader 0's information production incentives. If she passively reports the low state, then she will

earn d_l if her report turns out to be true and, *provided she is not crowded out*, will otherwise earn $\Delta P + d_l$. She can be incentivised to gather information instead by a sufficiently large discount d_h on hot issues. As λ decreases, passive reporting of the low state is more likely to be profitable, and so the hot issue discount d_h required to incentivise information gathering increases.

Now consider trader 0's incentives passively to report the high state. In this case she will earn the hot issue discount d_h whenever her report turns out to be correct and will otherwise lose $\Delta P - c$. *She will never be crowded out* and so decreases in λ only matter to her because they result through the effect already identified in a higher d_h. This has two consequences: it increases her profits from correct reports; and it reduces her losses from incorrect reports. She can be incentivised to gather information rather than to make this passive report by an increase in d_l.

For sufficiently low λ ($\lambda < \lambda^{l0}$), the hot issue discount d_h required to incentivise information production over passive low state reporting will be so high that the cold issue discount d_l required to incentivise information production over passive high state reporting will be strictly positive. This corresponds to condition 2 of proposition 2. For higher λ ($\lambda \geq \lambda^{l0}$), a lower hot issue discount d_h serves to incentivise information production over passive low state reporting and no cold issue discount is required to discourage passive high state reporting. This corresponds to condition 3 of the proposition.

Our conclusion that even "cold" issues should be discounted when $\lambda < \lambda^{l0}$ contrasts with the traditional argument that discounts compensate informed agents most efficiently when they are extended in positive feedback states (Benveniste and Spindt, 1989, and Benveniste and Wilhelm, 1990). This difference is a consequence of the asymmetric crowding out effects in high and low states of the world and the need to incentivise information production. In a slightly different context, Sherman and Titman (2002) obtain a similar result. In fact, we can go further. Since d_h incentivises information production, it must be increasing in the cost c of information. For sufficiently high c, d_h may be so high that passively reporting a hot issue can only be discouraged by a cold issue discount d_l which *exceeds* d_h. This occurs when IC_l intersects IC_h to the right of the intersection of IC_l and $d_l = d_h$ (point X in figure 1). It is easy to show that this occurs precisely when

$$c > \pi_l \Delta P.$$

4. Conclusion

Although there are many similarities in the way bookbuilding occurs in different countries, small changes in the "micro-structure" of the IPO process can have important implications. In this paper we have focused on one such detail: how differences in the interpretation of securities laws outside the U.S. (and Japan) allow the exchange of information between investors and the issuing bank prior to the bookbuilding period. As a result, the staging of the information revelation game changes significantly. In contrast to the existing literature, where all information is revealed during the bookbuilding period, in our model information acquisition takes place prior to establishing the initial indicative price range. A commitment to pricing within the indicative range promotes both costly information production and its revelation. This result assumes that it is possible for private information to be revealed exogenously to uninformed investors before the final offer price is set and that uninformed investors receive allocation priority in the event of oversubscription. Under these assumptions, the threat to informed investors of being crowded out of the offering if they fail to reveal positive information ensures information production and revelation.

This model suggests that for those countries where the exchange of information can occur before the bookbuilding period, the initial price ranges will be "sticky" and relatively unresponsive to demand as revealed during the bookbuilding stage. This is indeed what is observed. Outside the U.S., in only one tenth of IPOs is the final price set outside the initial price range. In contrast, nearly one-half of all U.S. IPOs are priced outside the initial range. Although it is tempting to infer that the unresponsiveness of prices to revealed demand outside the U.S. is inefficient, our model suggests otherwise. Furthermore, although we do not conduct a full analysis of the determinants of IPO pricing, the stylised facts we present are also consistent with our model. If significant information acquisition occurs prior to establishing the indicative price range for European IPOs, their indicative price ranges should be systematically more informative than indicative price ranges for comparable U.S. IPOs. For most countries, average IPO underpricing is no higher outside the U.S. notwithstanding the infrequent revisions to price ranges. However, there is some variation across countries (which, we suspect, may reflect other differences in their IPO micro-structure) and we leave for future research a systematic empirical analysis.

The model yields several testable hypotheses and implications for empirical analyses of European primary market data. First, the mechanism is more powerful if exogenous revelation of

private information is more likely. It seems plausible that this likelihood is a function of both firm (technological) characteristics and, more generally, the micro-structure of the IPO process in a given country. Similarly, it is plausible that the threat to informed investors of being crowded out varies across markets and time. Empirical applications or tests of the theory clearly warrant case-specific analysis of the plausibility of these assumptions.

Second, our model suggests that investors should earn rents for information revealed before the bookbuilding period. In a recent paper Aussenegg et al. (2002) conclude that the evidence from the German Neuer Markt is consistent with this prediction, and that the main role of the bookbuilding phase is to determine the allocation of the shares, rather than gather pricing-relevant information. Furthermore, Jenkinson and Jones (2002), in their analysis of 27 European IPOs, find that only 7% of bids submitted during the bookbuilding are price sensitive, and that there is no evidence that such bids are favoured in allocation. Again, this evidence is consistent with the predictions of our model.

The evidence on how investors bid in European bookbuildings is, however, varied. Using a sample of IPOs and secondary offerings (for both private sector issuers and privatizations) Cornelli and Goldreich (2001, 2002) document a much higher incidence of price sensitive bidding. They also find a direct correlation between price sensitive bids and both offer prices and the allocations received by bidders. We think it is unlikely that the banks studied by these authors failed to actively pre-market their IPOs, at least to European investors. It is likely, however, that more of their sample involved U.S. institutional investors in global offerings (only two of the IPOs studied by Jenkinson and Jones had U.S. tranches). The need to avoid significant communication with U.S. investors prior to registration suggests that information acquisition will differ markedly between domestic and global offerings. Ljungqvist, Jenkinson and Wilhelm (2003) suggest that more information per unit of reward might be extracted from U.S. investors. Thus even after seeking pre-marketing feedback for a global offering from potential investors outside the U.S., feedback from U.S. investors during the bookbuilding effort might remain informative at the margin. If so, price sensitive bids from (U.S.) investors might plausibly be rewarded with larger allocation and also prove more influential than others in determining the offer price. By contrast, the pre-marketing effort might serve as the dominant mechanism for acquiring information in domestic offerings. Consequently, we might expect both a stronger commitment to the indicative price range, and a weaker linkage between allocations and the price sensitivity of bids in the book, than would be observed for comparable

global offerings.

Finally, it is clear that our model relies on the assumption that significant exchanges of information occur between certain investors and members of the IPO syndicate before the bookbuilding. Whilst we have provided general evidence to support this assumption for European IPOs, there remains little direct and detailed evidence regarding the sort of information that is actually elicited. This pre-marketing phase of the bookbuilding process in Europe is an important area for future empirical research.

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Table I
Initial price ranges, offer prices and underpricing

This table presents information on the initial price ranges, where the final offer price was set, and the initial underpricing for IPOs conducted using bookbuilding. The sample period is January 1992 - July 1999, and information was derived from the Equityware database of IPOs. All figures are averages of the relevant samples. The width of the price range is measured as (high-point - low-point)/mid-point. Price adjustment refers to the position of the final offer price relative to the mid-point of the initial price range. Our measures of initial underpricing compare the end of first week market price to the mid-point of the initial price range and also to the issue price. For comparison the table includes information on U.S. IPOs conducted over the same period.

Country			Proportion of firms (%) priced ...					Initial underpricing (%)	
	number of IPOs	width of price range (%)	strictly below range	at low end	at high end	strictly above range	price adjustment (%)	relative to midpoint of range	relative to issue price
Austria	24	13.3	4.2	0.0	16.7	0.0	0.8	7.0	6.0
Belgium	45	15.6	6.7	6.7	37.8	8.9	1.6	24.7	22.4
France	178	14.3	2.2	9.6	42.7	2.8	3.0	18.9	14.6
Germany	219	16.1	1.8	7.8	71.7	0.0	4.8	57.1	48.9
Italy	59	20.6	5.1	1.7	32.2	1.7	1.7	10.3	7.9
Netherlands	60	15.0	3.3	5.0	48.3	13.3	5.7	19.3	12.0
Spain	28	14.0	0.0	7.1	46.4	7.1	3.7	15.0	10.5
Sweden	35	14.0	8.6	11.4	25.7	2.9	0.0	4.4	4.3
Switzerland	25	14.2	4.0	8.0	28.0	4.0	2.4	8.2	5.5
United Kingdom	141	19.2	22.7	5.7	20.6	10.6	-0.5	10.6	10.2
rest of W. Europe	75	16.7	6.7	6.7	41.3	10.7	3.9	20.3	15.1
rest of E. Europe	29	20.0	3.4	17.2	34.5	3.4	1.4	21.0	18.7
Total Europe	918	16.3	6.4	7.3	43.7	5.0	2.8	25.4	21.1
United States	3480	15.2	24.5	11.0	12.6	23.6	0.8	23.0	18.3