

## **Signalling and Ownership Arguments as Explanations for Underpricing: an Overview**

by S. VANDEMAELE\*

### I. INTRODUCTION

In an article titled "Auctions and Auction-Like Underpricing Theories" that appeared in the September 1997 issue of the *Tijdschrift*, a category of underpricing theories was reviewed which heavily borrows from the auction literature (auction-like underpricing theories)<sup>1</sup>. The models reviewed there are based on an asymmetric information structure: at the initial public offering (IPO), some outsiders have superior information about the market value of the shares being offered.

The present article, in contrast, deals with signalling and ownership arguments. A signalling situation arises if, at the time of the IPO, the issuing firm is better informed about its own business situation. This asymmetry can affect pricing because issuers have an incentive to misrepresent themselves to potential investors as higher quality than they actually are. The signalling theories posit that issuers who possess favourable private information, that is, who know the expected firm value is high, may want to distinguish themselves from their counterparts with unfavourable private information by issuing at "too

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\* Departement Toegepaste Economische Wetenschappen, K.U.Leuven, Leuven, en Departement Bedrijfskunde, Limburgs Universitair Centrum, Diepenbeek.

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low" a price. Thus, while in the auction-like underpricing theories proceeds maximising issuers reluctantly underprice because of regulatory and/or other constraints<sup>2</sup>, in the signalling models, issuers willingly underprice because of signalling considerations. The unique feature of the latter models is that the price itself is used as a tool.

Next to the signalling theories, this chapter reviews two ownership arguments that have been advanced to explain the well documented underpricing phenomenon. Contrary to the auction-like and signalling theories, the ownership arguments do not presume the existence of a particular form of information asymmetry. Ownership theories have in common with signalling theories, however, that they posit that issuers may value the freedom of setting the offer price "arbitrarily low".

The article is organised as follows. Section II is devoted to studying the main aspects of the signalling and ownership theories. Section III gives an overview of the empirical implications of the signalling and ownership theories and section IV reviews the most important tests thereof. Section V considers other signalling variables that have been advanced in the literature and that could be used as substitutes for, or as complements to, the underpricing signal. Section VI evaluates and concludes.

## II. SIGNALLING AND OWNERSHIP THEORIES

### A. *Signalling Theories*

Three models that explain underpricing as a signalling device are discussed: Allen and Faulhaber (1989), Grinblatt and Hwang (1989) and Welch (1989). The models basically have the same structure. First, the signalling models assume that the firm itself best knows its prospects: the entrepreneur has better information about his firm's future cash flows than outside investors. The typical model assumes that the entrepreneur owns an investment project that requires a capital outlay. The project still has to be undertaken, and the entrepreneur possesses some proprietary information as to its nature and potential success. The entrepreneur, in need of capital, sells a fraction of the project to the market through a new share issue. Second, the three signalling models are based on a dynamic (multi-period) analysis: all models assume that the entrepreneur, in need of additional capital or wanting to hold a more diversified portfolio, also sells additional shares some

time after the initial public offering. Between the first and the second issue, information is revealed with a strictly positive probability and there is a chance that the firm's nature becomes known to the public. The objective of the firm is to maximise the long-term proceeds over all issues.

The sequence of events in the signalling models can be represented as a game. In its extensive form, an informed potential issuer moves first, by setting an introduction price. Numerous (identical) uninformed investors, in perfect competition with each other, move in response. Their actions consist of acceptance or rejection of the initial offering at date 0, and the setting of prices in the secondary market at date 1. One possible outcome of the game, then, is a signalling equilibrium, where the high-quality firm communicates its quality to outside investors by underpricing, while the firm with the bad project does not find it optimal to imitate the high-quality firm and, hence, does not underprice<sup>3</sup>. Such a signalling equilibrium has two characteristics. First, firms that underprice must be good, because only good firms can recoup the losses through reissuing activity. Moreover, the increase in issue proceeds in subsequent offerings must be greater than the foregone issue proceeds of the IPO due to underpricing. The models are in the spirit of Ibbotson's (1975, p. 264) conjecture that IPOs are underpriced to "leave a good taste in investors' mouths", so that future issues can be sold at attractive prices. In the signalling models, investors become informed by the low price itself: underpricing is an equilibrium signal of firm quality<sup>4</sup>. We now review each of the signalling models in more detail.

Allen and Faulhaber (1989) assume that there are two types of firms: good and bad firms. Good firms have higher expected dividend streams than bad firms. A good firm's type can change over time: a good firm can become bad if the undertaking of the available investment project is not successful. Issuers are risk-neutral. Therefore, their utility depends only on the sum of the issuing proceeds from an initial public offering and a subsequent seasoned offering. Also, outside investors are risk-neutral and they update their beliefs between the IPO and the reissuing activity on the basis of the amount of dividends paid out by the firm. Their posterior beliefs determine what they are willing to pay at the secondary offering. Under certain parameter restrictions, a signalling equilibrium results, where high-quality firms underprice, because, by doing so, they condition investors to more favourably interpret subsequent dividend results.

Welch (1989) also assumes that there are two types of firms and that issuers and investors are risk-neutral. In Welch' model, firm type is fully revealed with a strictly positive probability (strictly less than one) in some exogenous way. Welch assumes that the high-quality firm (high cash flow) has to incur costs to be operational. To imitate the good firm, a bad firm (low cash flow) also has to expend these costs. While good firms can recoup these costs later, bad firms cannot. When imitation costs are not sufficient, underpricing by high-quality firms adds the additional wedge that induces low-quality firms to voluntarily reveal their nature.

The model of Grinblatt and Hwang (1989) is the most general model: it is a general-equilibrium model that introduces risk aversion of issuers/investors and a continuum of issuer types. The introduction of risk aversion makes the variance a relevant parameter in the valuation issue<sup>5</sup>. The model of Grinblatt and Hwang builds on that of Leland and Pyle (1977). While Leland and Pyle assume that risk-averse investors do not know the expected value of the project, but know its variance, Grinblatt and Hwang assume that both the mean and variance of the project are unknown to outside investors (and known to insiders)<sup>6</sup>. And, while in Leland and Pyle the fraction of shares retained by (risk-averse) insiders at the time of the IPO is a signal of a firm's expected level of cash flows, Grinblatt and Hwang need two signals, the fraction of shares retained by insiders and the amount of underpricing, to convey the two unknown attributes to outside investors. To obtain this result, Grinblatt and Hwang assume, like Allen and Faulhaber (1989) and Welch (1989), but unlike Leland and Pyle (1977)<sup>7</sup>, that the issuer sells additional shares to the market some time after the IPO. As in Welch' model, there is a (strictly) positive probability that investors learn the true expected value of the project between the initial public offering and the subsequent offering. Given the sequence of the events and the parameters of the model, the issuer maximises the expected utility of his wealth at the date of the secondary offering. The decision variables are (a) the fraction of shares sold at the IPO (and, therefore, the fraction of shares sold at the secondary equity offering, the one being the complement of the other) and (b) the level of the discount offered at the IPO. The result of the analysis is a Pareto-efficient signalling equilibrium, in which underpricing and the fraction retained by insiders together signal the mean and variance to outside investors.

An interesting variant on the signalling models is the model of Chemmanur (1993). The structure of the latter model is similar to that of the previous ones, but it is not a signalling (separating) model in the sense of leading to the identification (separation) of the firms at the time of the IPO. As in the signalling models, insiders have private information about their firm's prospects, and insiders sell stock in both the IPO and the secondary market. Chemmanur assumes that there are two types of firms (good and bad firms) and that issuers and investors are risk-neutral. Furthermore, as in the signalling models, issuers maximise their expectation of the combined proceeds from the two sales of equity. Before bidding in the IPO, outsiders can conduct an "evaluation" of the firm at a cost  $C$ , which gives them additional (but still noisy) information about firm type. In the equilibrium outcome, only information producers who obtain good evaluations bid in the IPO, while those with bad evaluations invest in the riskless asset. If information has positive value, the proportion of information producers who bid for shares can always be expected to be higher for a high-value firm than for a low-value firm. The model implies that, the greater the amount of information produced by outsiders, the closer the expected secondary-market price of either firm type is to its true value. Underpricing, then, is the tool by which high-value firms influence the equilibrium amount of information producers: since information production is costly, only a lower share price will induce more outsiders to acquire information. As previously stated, the outcome of the model is not a "separating" equilibrium, but rather a "pooling" equilibrium where outsiders cannot distinguish between the two firms at the initial public offering and where the nature of the firm is (partly) revealed in the after-market price. The issuers benefit from the reflection of the result of the information processing activities in the after-market price when they subsequently issue shares. Chemmanur's model has an (indirect) implication for the post-IPO ownership base of the issuing firm: underpricing leads to a more diffuse ownership base.

### *B. Ownership Arguments*

Next, we review two recent papers that explicitly advance ownership considerations as a possible explanation for underpricing. The idea behind the model in Booth and Chua (1996) is similar to that in Chemmanur (1993): underpricing promotes oversubscription, which allows

broad post-IPO ownership. In the paper of Booth and Chua, broad ownership is valued because it increases secondary-market liquidity, which in turn reduces the required return to investors. The information structure of the model of Booth and Chua is different, however, from the previous (signalling and pooling) models, in that no ex-ante information asymmetry exists between the issuer, investment banker or outside investors. Initially, everyone possesses equally noisy information. Investors can engage in costly information production, and, if they choose to do so, become part of the potential investor base. Issuers maximise issue proceeds at the introduction. Issue proceeds equal estimated firm value minus total information costs. Both the issue proceeds and the information costs depend on the level of oversubscription. Firm value is assumed to be increasing in the level of oversubscription at a decreasing rate, while information costs are assumed to be increasing in the level of oversubscription at an increasing rate. The information costs increase at an increasing rate since the issue is assumed to be promoted to that segment of the market with the lowest costs of acquiring information first. Proceeds are maximised when the rate of increase in total information costs (and equilibrium underpricing) equals the rate of increase in the total market value of the firm. In equilibrium, investors recover information costs through the price discount in the IPO.

Brennan and Franks (1996) also value underpricing as a means of influencing the ownership base. They do not formally build a model, but they advance the "reduced monitoring" hypothesis. They argue that one benefit of underpricing at the IPO is that the resulting oversubscription allows the issuer both to ration the allocation of shares and to discriminate between applicants so as to reduce the individual size of new post-IPO block holdings. The greater dispersion of outside holdings reduces the incentives for the new shareholders to monitor the current management.

### III. EMPIRICAL IMPLICATIONS OF THE SIGNALLING AND OWNERSHIP MODELS

#### A. *Empirical Implications of the Signalling Models*

A common element in the signalling models and in the pooling model of Chemmanur (1993) is that issuing firms recoup the cost of underpricing through reissuing activity<sup>8,9</sup>. Therefore, a first testable im-

plication is that firms that underprice more, are more likely to issue seasoned equity some time after the IPO. Another conjecture is that these firms will issue larger amounts of seasoned equity or will issue more quickly after the IPO, than firms that underprice less.

In all signalling models, it is the good firm that underprices, the bad firm being priced at its (low) intrinsic value. This predicts a positive relation between the firm's intrinsic value and underpricing. Allen and Faulhaber (1989) are explicit about the characteristics of the high-value firm: in their (two-period) model, a high-value firm has a higher (expected) dividend stream. Hence, they formulate a more specific prediction, namely a positive relation between the degree of underpricing and the subsequent dividend stream (earnings performance) of the firm.

Because Allen and Faulhaber (1989) specify the nature of the information on the basis of which investors update their beliefs between the IPO and the secondary equity offering, it is possible to construct some tests concerning these updating activities. In particular, they predict that firms that underprice less should experience a less favourable price reaction at the time of the dividend announcement.<sup>10</sup>

Chemmanur (1993) and Welch (1989) hypothesise that an (exogenous) change in the prior probability of the firm being of high quality could be responsible for the existence of "hot issue" and "cold issue" markets, i.e. periods across which the extent of underpricing differs significantly<sup>11</sup>. Welch' model implies that the prior probability that a firm is of high quality and the probability that it underprices are negatively related. This is because firms will switch from an underpricing to a pooling equilibrium when the proportion of high-value firms increases sufficiently<sup>12</sup>. In Chemmanur's model, an increase in the proportion of good firms is negatively related to the extent of underpricing, although it does not lead to a change in equilibria played (there is only one (pooling) equilibrium). Both propositions are based on the same idea: when the proportion of high-quality firms increases, the cost of being pooled (and thus receiving the average value for their shares) at the IPO decreases for the high-value firm, and thus the benefit of underpricing is reduced.

Because Grinblatt and Hwang (1989) formally incorporate the variance of the project in their model (next to the mean of the project), two signals are needed to convey firm value to investors: ownership retention by insiders after the IPO and underpricing. Their model

leads to the following unique predictions, related to the interaction between insider holdings, underpricing and the value of the firm:

- (i) Given the issuer's fractional holdings, the degree of underpricing is an increasing function of the variance.
- (ii) Given the issuer's fractional holdings, firm value is positively related to the degree of underpricing.
- (iii) Given the variance of the firm, the degree of underpricing is positively related to the issuer's fractional holdings.
- (iv) Given the variance of the firm, firm value and the degree of underpricing are positively related.

In all signalling models, if agents are in an underpricing equilibrium, there exists no residual uncertainty as to the nature of the firm. Therefore, Welch (1989) predicts low residual uncertainty for firms that underprice. The formulation is a bit unfortunate, however, because the bad firms that do not underprice also face low residual uncertainty in the underpricing equilibrium. The question then is how one could separate firms that play an underpricing equilibrium from firms that play a pooling equilibrium. And even if this were possible, the difficult task remains of finding a good proxy for "residual uncertainty" in the framework of the signalling models that introduce risk neutrality (Allen and Faulhaber (1989) and Welch (1989)). It thus seems that the predictions of Grinblatt and Hwang (1989) about the relation between uncertainty (in terms of the project's variance) and underpricing are the only valid (and testable) ones in the framework of the signalling models.

### *B. Empirical Implications of the Ownership Models*

Chemmanur (1993), Booth and Chua (1996) and Brennan and Franks (1996) have implications for the post-IPO ownership structure. Chemmanur (1993) predicts that the extent of underpricing and the number of bidders are positively related. An equivalent prediction is that of a negative relation between underpricing and the probability of receiving an allocation. Brennan and Franks (1996) predict that underpricing reduces the block size of new shareholdings. In the latter paper, some predictions on the ownership structure in the longer (post-IPO) term are made: because of the suggestion that, at the IPO, insiders are concerned about losing power, it is predicted that insiders of firms that heavily underprice effectively remain in control some time after the IPO. In Chemmanur (1993) and Booth and Chua (1996),



underpricing is a compensation for the cost investors incur to become informed. In the paper of Brennan and Franks (1996), the underpricing discount is pure profit to investors. Hence, while the latter study does not imply anything for the relation between investor-borne costs to become informed and underpricing, the former models suggest that the extent of underpricing is increasing in the cost of information production.

#### IV. EMPIRICAL STUDIES

##### A. *Empirically Testing Signalling Arguments*

Compared to the empirical studies that followed Rock's (1986) theory and the related theories that invoke auction arguments (e.g. Beatty and Ritter (1986), Carter and Manaster (1990)), there is only a relatively small number of papers with empirical tests of the predictions of the signalling or ownership theories. This may be due to the difficulty of finding the "right proxies" to be introduced in a valid test of the theories.

Concerning reissuing activity, Welch (1989) presents preliminary evidence on reissuing activity by IPO firms. Of the 1028 sample firms that did an IPO between 1977 and 1982, 288 firms reissued a total of 395 public seasoned equity offerings over the same period. IPO firms that reissue do so for a substantial amount: for reissuing firms, the ratio of secondary offering proceeds over IPO proceeds is in excess of 3.

Jegadeesh, Weinstein and Welch (1993) also focus on the reissuing activity of firms. They examine the relationship between IPO returns and the characteristics of subsequent seasoned equity offerings by analysing 1985 US IPOs from 1980 to 1986. In particular, they examine whether firms that underprice more at the time of the IPO are (1) subsequently more likely to issue seasoned equity (logit regression); (2) more likely to issue larger amounts of seasoned equity (tobit regression where the independent variable is the size of the secondary equity offering relative to the IPO size); (3) more likely to issue seasoned equity sooner after the IPO (OLS regression with the time lag between the secondary equity offering and the IPO as dependent variable).

Jegadeesh, Weinstein and Welch (1993) also consider an alternative explanation: the market feedback hypothesis. This hypothesis pos-

its that the market provides the issuer with additional information about the intrinsic value of the shares. A higher than expected after-market price conveys the information that the issuer has underestimated the future cash flow of the project. The issuer is likely to use this information and to increase the scale of his project by raising additional capital through seasoned offerings. The signalling and the market feedback hypotheses have different predictions about the role of IPO underpricing in the reissue decision. Under the signalling hypothesis, the return on the IPO date plays a prominent role: the issuer signals its quality only through IPO underpricing. The signalling hypothesis allows new information to be revealed also in the after-market period, but (at least during short after-market periods) this information is likely to be unimportant relative to the information conveyed in the initial returns. Under the market feedback hypothesis, in contrast, (abnormal) share price changes in the after-market could have the same, or even a more important, effect on future equity issues compared to the effect of initial price changes at the issue date. In fact, under the market feedback hypothesis, underpricing is exogenous to the decisions related to the subsequent seasoned offering, while it is endogenous under the signalling hypothesis. (Residual) initial underpricing (the error term after regressing underpricing on proxies for market valuation uncertainty) and the abnormal return over the period from trading day 1 (21) to trading day 20 (40) are included as explanatory variables in the three regression tests. The coefficient estimates on the variables may enable one to distinguish between the two hypotheses. Although the results indicate a positive relation between IPO underpricing and the probability and size of the subsequent seasoned offerings, and thus are consistent with the implications of the signalling models, the economic significance appears to be weak. Additional specification tests favour the market feedback hypothesis.

The paper of Keloharju (1993) examines the same issues as Jegadeesh, Weinstein and Welch (1993) but it uses Finnish data and applies somewhat more sophisticated econometric techniques. In a sample of 91 IPOs, Keloharju finds evidence of a positive relation between underpricing and the probability of a subsequent seasoned equity offering, and of a negative relation between underpricing and the time span between the IPO and the secondary offering, consistent with the predictions of the signalling theories. Contrary to the predictions of the signalling models, there seems to be no relationship between

IPO underpricing and the relative size of the seasoned offering. It appears that there are strong comovements in the issuing activity of Finnish listed companies: introducing a variable proxying for seasoned-offering activity considerably increases the explanatory power of the models. The specification tests are not powerful enough to differentiate between the signalling and the market feedback hypotheses.

Garfinkel (1993) uses a broader definition of a "seasoned offering", compared to that used in earlier tests of the signalling hypothesis. The signalling (and pooling) models indeed provide little guidance as to what constitutes a "seasoned offering". The concept could refer to equity offerings, offerings of risky and convertible debt and open market sales by insiders. Indeed, any claim on the firm sold to the market could allow the issuer to recoup the costs of underpricing. Garfinkel examines the relationship between underpricing and the likelihood that a firm will issue seasoned equity, and the relationship between underpricing and the likelihood that insiders sell shares in the open market for a sample of 549 US firms that were introduced between 1980 and 1983. He uses the logistic estimation procedure and introduces as explanatory variables unexplained underpricing (error term after regressing underpricing on proxies for market valuation uncertainty) and the cumulative raw return from the stock for 200 days following the end of the first trading day. The coefficient for residual underpricing is insignificant and positive, while the coefficient for the return variable is significant and positive. Thus, it seems that both the likelihood of a firm reissuing and of insiders selling shares in the open market are more determined by the returns of the firms following the IPO (market feedback hypothesis) than by initial underpricing.

Michaely and Shaw (1994) extensively test the implications of the various signalling models on 889 US firms that were introduced between 1984 and 1988. First, they carry out the tests reviewed above concerning the relation between the success of reissuance and underpricing. "Success" of the seasoned issue is measured in terms of the size of the issue and the market reaction to the issue announcement. Because decisions on how much to underprice and whether (or how much) to reissue are not independent, they test a simultaneous equations model. In a first equation, the dependent variable is the initial underpricing and the independent variable is the size of the equity (debt) issue relative to the IPO size. In a second equation (tobit), the dependent variable is the relative size of the seasoned issue and the

independent variables are underpricing, the excess return in the 60 days after the IPO and the two years after the IPO. The results of the estimation exercise show: (1) a statistically insignificant coefficient associated with the relative issue size in the first equation; (2) a statistically significant negative coefficient associated with the initial return in the second equation, indicating that the likelihood of a seasoned offering is inversely related to the initial return; (3) a statistically significant positive coefficient associated with the 60 day and 2 year post-IPO returns, indicating that firms that perform well after the IPO tend to issue more equity (market feedback hypothesis). They regress the excess return on the three days surrounding the announcement of seasoned issue on underpricing, the relative size of the seasoned issue, the time lapse between the IPO and the seasoned offering, and the Mill's ratio (to account for a possible truncation bias); they find that the initial-return coefficient is negative and significant, implying that stocks that underprice more, experience less favourable price reactions at the time of the seasoned issue.

Next, Michaely and Shaw (1994) test the implications of the model of Allen and Faulhaber (1989) that (1) there is a positive relation between the degree of underpricing and the subsequent earnings performance and dividend policy of the firm and (2) firms that are less underpriced experience a less favourable price reaction when the dividend is announced. To test the first implication, Michaely and Shaw regress the initial return at the IPO on the dividend yield, a dummy variable for dividend-paying versus non-dividend-paying firms, and the reciprocal of the interval between the IPO and the first dividend announcement (0 if no dividend is paid). Contrary to the prediction, both the dividend-yield coefficient (significant) and the dividend-dummy coefficient (insignificant) have a negative sign, implying a lower initial return for dividend-paying stocks. The coefficient for the interval between the IPO and the first dividend is negative and significant. It thus seems that firms that underprice less tend to have higher dividends and pay them sooner rather than later, contrary to the prediction of the signalling models. To test the second implication, they regress the excess return on the three days surrounding the announcement of the first dividend on underpricing, the dividend yield and the time lapse between the IPO, the first dividend payment and Mill's ratio (to account for a possible truncation bias). The initial-return coefficient is negative (insignificant), implying that a higher initial re-

turn is associated with a smaller subsequent dividend payment, again in contrast with the prediction of the signalling models.

Third, Michaely and Shaw test the specific predictions of the Grinblatt and Hwang (1989) model that (1) the initial return from the IPO and the fraction held by insiders are positively related, for a given variance level; (2) firm value and the degree of underpricing are positively related, given the fraction held by insiders and (3) firm value and the degree of underpricing are positively related, given the level of variance. They estimate a regression where the initial return is the dependent variable and the estimated variance of the security in the 60 days after the IPO together with the fraction of insider holdings are the explanatory variables. The coefficients on both variables are, however, insignificant. In another regression, they relate firm value to underpricing and the variance of the after-market return; and in yet another regression, they relate firm value to underpricing and insider holdings. Firm value is estimated as the percentage change in its equity value from its second day of trading to the two-year trading date, calculated as the two-year excess return, including dividends. In the latter two regressions, again, no variable has significant explanatory power.

### *B. Empirically Testing Ownership Arguments*

We now turn to the empirical papers that try to discover ownership considerations in IPO underpricing data. Booth and Chua (1996) advance the idea that cross-sectional differences in underpricing are related to measures of pre-bid information costs. They build their test on two arguments. First, the cost of achieving ownership dispersion and corresponding secondary-market liquidity will be larger for best-efforts issues, compared to firm-commitment offerings, for the following reasons: (a) the former issues are much smaller and riskier, on average (Ritter(1987)); (b) furthermore, contrary to a firm-commitment offering, best-efforts offerings are withdrawn in the case of insufficient demand. In that case, there is no compensation for investor-borne information costs. Because these costs should be compensated for in the best-efforts submarket, best-efforts issues are on average more underpriced than firm-commitment offerings. The second argument underlying the Booth and Chua test is that the clustering of (similar) issues over time will cause information spillovers, lowering total information costs of individual issues and thus reducing un-

derpricing. Since both the information costs and underpricing of best-efforts issues are larger, these issues are expected to benefit more from clustering compared to firm-commitment offerings. The sample of Booth and Chua consists of 2151 IPOs, of which 1930 are firm-commitment issues and 221 are best-efforts issues. Booth and Chua regress underpricing on a dummy variable for firm-commitment versus best-efforts offerings, an interaction term for firm-commitment offerings and the underwriter prestige, an interaction term for best-efforts offerings and the underwriter prestige, the total number of IPOs in the three calendar months preceding the issue, an interaction term for best-efforts offerings and the total number of IPOs in the three calendar months immediately preceding the (best-efforts) IPO, the total number of IPOs in the same industry in the 12 calendar months preceding the issue, and an interaction term for best-efforts offerings and the total number of IPOs in the same industry in the 12 calendar months preceding the best-efforts issue. They use underwriter prestige interaction terms because from the previous IPO literature, investment banker prestige is expected to be more important for firm-commitment than for best-efforts issues. The intensity with which new issues come to the market three calendar months prior to a particular issue is expected to reflect the clustering of issues which would tend to lower information costs, and thus underpricing. Because of its hypothesised differential impact on the underpricing of best-efforts issues compared to firm-commitment offerings, an interaction term is introduced. A similar logic applies to the industry issue intensity. The results of the estimation show: (1) a significantly negative coefficient on the firm commitment-underwriter prestige interaction variable; (2) a significantly negative coefficient on the general IPO intensity index; (3) a significantly negative coefficient on the general IPO intensity-best efforts interaction variable. Thus, the results are consistent with (1) investment banker prestige playing an important role in reducing information costs for firm-commitment issues; (2) information spillover effects lowering information costs when issues are clustered in time; (3) larger benefits to clustering issues when information costs are high.

Thanks to the complete details of the rationing schemes applied in 69 UK IPOs marketed in the period 1986-1989, Brennan and Franks (1996) document the existence of a general policy of rationing and discrimination against large applicants. A simple regression estimate shows that for each 1% change in underpricing there is, on average, a

0.64% change in oversubscription. They also provide evidence that directors tend to retain control at and after the introduction. At the IPO, three quarters of sales by pre-IPO investors are from non-directors. By the end of the sampling period considered (1993), holdings of directors are reduced by about one third, from 42% of the pre-issue number of shares outstanding prior to the IPO to 29%. In contrast, holdings of non-directors are virtually eliminated over the same period.

## V. OTHER SIGNALS: SUBSTITUTES FOR OR COMPLEMENTS TO THE UNDERPRICING SIGNAL?

### A. *Introduction*

When evaluating signalling models and the empirical studies thereof, an important element has to be considered. The signalling models studied in the previous sections suggest that the firm can credibly convey information through the pricing of the issue. An important question in the evaluation of any signalling model is whether the signal being examined would be used if the firm had a wider menu of signals available. In the context of IPOs, firms typically can signal their quality with several variables other than the offer price. Below, we review three papers that present other signalling instruments that can be used by issuers to convey private information at the time of the IPO.

### B. *Theories*

Three variables (next to underpricing) have been advanced in the literature that can be used to signal private information about the (mean) level of the firm's cash flows to outside investors at the time of the issue: (1) the proportion of equity shares retained by insiders (Leland and Pyle (1977)); (2) the firm's choice of auditor/underwriter (Titman and Trueman (1986)); and (3) the firm's choice of underwriter (Booth and Smith (1986)). The models by Titman and Trueman (1986) and Booth and Smith (1986) assume that investors are risk-neutral, and, therefore, that the variance of the firm's cash flows is irrelevant in the valuation of an all-equity firm. Leland and Pyle (1977) assume that investors are risk-averse but know the variance of the project and its covariance with the market portfolio. In these three

models, therefore, there is no need to signal variances and/or covariances.

Leland and Pyle (1977) show that a Pareto-efficient equilibrium exists, where the insiders' optimal choice of the fraction of shares retained after the IPO is a strictly increasing function of the quality of the inside information (mean level of the firm's cash flows). The fraction of equity retained can act as a signal because it is less costly for risk-averse insiders of high-value firms to hold an undiversified portfolio than for risk-averse insiders of low-value firms<sup>13</sup>.

Titman and Trueman (1986) show that a Pareto-efficient equilibrium exists, where the entrepreneur's optimal choice of auditor/investment banker quality is a strictly increasing function of the quality of his inside information (mean level of the firm's cash flows). High-value firms find it worthwhile to incur the higher cost of a high-quality auditor because the latter provides more precise estimates of true firm value (high expected level of cash flows) to outsiders.

Booth and Smith (1986) advance, similarly to Titman and Trueman (1986), the idea of a certification role of the underwriter: thanks to his non-salvageable reputational capital, he is able to certify that the issue price reflects available inside information. Underpricing can occur because underwriters may build their reputations by deliberately underpricing, and absorbing the underpricing loss. Even underwriters with established reputations can underprice to protect their reputations. Furthermore, discounting can be used in addition to certification, when full certification of the issue is too costly.

### *C. Evaluation*

From the above analysis, it follows that, in the models of Leland and Pyle (1977) and Titman and Trueman (1986), underpricing is not considered as a possible signal. The proportion of equity retained and the choice of the auditor can, therefore, be considered as substitutes for the underpricing signal<sup>14</sup>. In Booth and Smith's (1986) model, to the contrary, underpricing can be used as a signal in complement to the choice of the underwriter.

When it comes to empirically testing signalling models, it is important to be aware of three possible "signalling situations": (a) two signals are used to convey two different attributes (for example, Grinblatt and Hwang (1989)), (b) one signal is used in complement to another to convey one single attribute (for example, Booth and Smith



(1986)) or (c) two signals are viewed as substitutes, and, thus, the use of one signal makes the other signal redundant. Determining which case prevails is essentially an empirical matter.

## VI. EVALUATION AND CONCLUSION

Signalling theories (Allen and Faulhaber (1989), Grinblatt and Hwang (1989) and Welch (1989)) argue that issuers who possess private information at the time of the IPO, may want to "leave a good taste in investors' mouths" in light of future (primary or secondary) share issues. While all signalling theories model the recuperation of underpricing costs through reissuing activities, in reality, other ways of recuperating the discount can exist. The positive publicity surrounding an IPO issued at a substantial discount could, for example, lead to a boost in sales. Alternatively, relatively high underpricing at the IPO could be a means of signalling firm value to a potential bidder and, hence, it could result in a higher (expected) take-over value.

While Chemmanur's (1993) model is reviewed in this chapter because it is similar in structure (private information structure/subsequent equity issue) to the signalling models, it is interesting to point out the similarity between the argument of Chemmanur (1993) and that of Benveniste and Spindt (1989), which is an auction-like model of information extraction (Vandemaele (1997)). In fact, the argument is essentially the same in both papers, but it is applied under a different information structure. Both papers value the information acquisition process by outside investors. In Benveniste and Spindt, there is no private information possessed by insiders at the time of the IPO; hence, the information acquisition process essentially concerns the processing of information available to (some) outsiders at the time of the IPO, and issuers are willing to pay something (in terms of underpricing) to have the result of this information processing activity reflected in the offer price. In Chemmanur, issuers possess private information at the time of the IPO, hence the information acquisition process basically concerns the processing of the (previously private) information when it becomes public some time after the IPO. Again, issuers are willing to pay something (in terms of underpricing) to have the result of their information processing activities reflected in the after-market price, from which they benefit in the case of a subsequent share offering.

Next to the signalling models and the (related) model of Chemmanur (1993), two recent papers, Booth and Chua (1996) and Brennan and Franks (1996) have explicitly advanced the willingness of a firm to attain a dispersed ownership base after the introduction as a possible cause for underpricing.

The review of the empirical results leads us to the conclusion that, all by all, little evidence is found in support of the signalling explanation. The general finding is that there is important reissuing activity after the IPO; most of the tests, however, favour the market feedback hypothesis rather than the signalling hypothesis. The other implications of the signalling models have been tested infrequently; again, few tests support the signalling explanations. A general problem when it comes to empirically testing the signalling hypotheses is that of data availability. Because data on non-public primary and/or non-equity primary offerings and data on secondary share sales subsequent to the IPO are not generally available, most studies use a restrictive definition of seasoned offerings by only considering public seasoned equity offerings. All other claims that a firm or its owners may sell, including risky and convertible debt, equity issues that are not offered to the public, and open-market sales by insiders are ignored. Such a restrictive definition of seasoned offerings biases the results against the prediction that firms reissue substantially after the IPO. Furthermore, a firm may recuperate underpricing costs through other means than through reissuing activity. Therefore, a comprehensive test of the signalling argument should take into consideration these other means of recuperating the discount, together with reissuing activity.

Brennan and Franks (1996) present the only (extensive) empirical test that explicitly considers ownership considerations: the paper suggests that, at least in the UK, these considerations may be important in pricing IPOs.

#### NOTES

1. An internationally well-documented and very puzzling phenomenon is the fact that a buyer of a newly issued stock almost surely makes a substantial return on the first day of trading. Shares thus appear to be "underpriced", on average, at the time of an initial public offering. The theories that try to offer a rational explanation for the underpricing phenomenon are called underpricing theories.
2. For example, in Rock's (1986) model, underpricing is a cost imposed on the issuing firm by the informed bidders.

3. Next to a signalling (separating) equilibrium, semi-separating and pooling equilibria can exist. In a semi-separating equilibrium, the probability that the bad firm mimics the good firm and, hence that investors cannot distinguish between good firms and bad firms at the time of the IPO is strictly between zero and one. In a pooling equilibrium, this probability equals one.
4. The underpricing signalling models have a structure similar to that of any signalling model in the economics literature. In the general signalling model, signalling agents have superior information. Agents with favourable information reveal their superior quality by "burning money".
5. If investors are risk-neutral, the variance of the cash flows is an irrelevant parameter in the valuation of an all-equity firm.
6. Grinblatt and Hwang (1989) assume that the cash flows of the project and uncorrelated with the returns of the market portfolio in periods 1 and 2. In addition, the issuer's objective function is directly assumed to take the form:  $E(W_1) - 1/2\text{var}W_1$ , where  $W_1$  is the issuer's wealth at the end of period 1 and  $\text{var}W_1$  is the variance of that wealth. Therefore the variance of the project is relevant to the valuation issues.
7. The model of Leland and Pyle (1977) is, in fact, only valid if there is a commitment device that ensures that insiders will not sell out shortly after the IPO. This is the principal weakness of this model.
8. Implicitly, this is also a feature of the model by Booth and Chua (1996). Owners value underpricing, because it increases ownership dispersion, which, in turn, increases liquidity and decreases the required return. Issuers can only profit from the latter if, at some time, they sell securities.
9. In section VI, it is argued that other means, next to reissue activity, exist the recuperate underpricing signalling costs.
10. Along the same lines, Welch (1989) formulates a hypothesis about investors' updating activities at the time of the secondary equity offering: he predicts that firms that underprice more will experience a more favourable stock price reaction at the time of the secondary equity offering. This prediction, however, is more a speculation than a direct implication of the signalling model. In the signalling equilibrium of Welch - the only equilibrium in his model where underpricing occurs - a firm's nature is fully revealed by the time of the secondary equity offering; therefore, actions at this time do not add any new information about the intrinsic value of the firm. Welch argues that in reality, however there could be residual uncertainty about firm value, and a subsequent offering may resolve some of the remaining uncertainty. But if this were the case, then, again, the outcome of the game is not an underpricing (separating) equilibrium, but one of the other possible equilibria. Therefore, I doubt that price reactions at the time of the secondary equity offering could serve as the basis of a test of Welch' model.
11. Ibbotson and Jaffe (1975) are the first to provide evidence of the influence of market conditions on IPO pricing. They document that there have been a number of periods in which initial public offerings of common stock have had extremely high initial returns. Such periods are termed "hot issue" markets.
12. The same argument, although not explicitly stated; is valid in the framework of Allen and Faulhaber (1989). The prior probability in their model is the prior probability that the firm remains good, because in their model, an initially good firm can become bad if the implementation of the project is not successful.
13. It is interesting to recall the model of Grinblatt and Hwang (1989) (Section II.A), which is basically the model of Leland and Pyle (1977), argued with (risk-averse) investors not knowing the variance of the firm's cash flows. Therefore, issuers will use underpricing together with the proportion of the equity retained to signal the two attributes to investors.
14. There is, however, an important difference with respect to the use of one or the other signal. As argued previously, the use of the underpricing signal can only "pay" if the firm reissues some time after the IPO. No such reissuing activity is necessary to make the proportion of equity retained or the choice of an auditor (underwriter) "profitable" signals.

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