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Diskussionsbeitrag 02-03

Underpricing Initial Public Offerings due to the Value Increasing Publicity Effect

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ISSN 0949-6610

Januar 2002

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Abstract: Models explaining underpricing of initial public offerings assume the firm's value to be independent of the process of the offering itself. We dispense with this restriction by assuming that a high underpricing can trigger publicity, which in turn raises the firm's value via the operating performance. The derived model can explain underpricing even in the absence of information asymmetry on the stock markets. A hypothesis on the underpricing strategy of certain enterprises is proposed. We take first steps towards an empirical test of the hypothesis.

Keywords: Initial public offerings, underpricing, publicity.

JEL-classification: G24, G35, G12.

This version: January 23, 2002.

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* We would like to thank the participants of the 2000 ABN AMRO International Conference on Initial Public Offerings — especially our discussant Chad Zutter, Juliane Godehardt, Christoph Kaserer, Laurie Krigman and Andreas Pfingsten for helpful comments. All errors are our own.

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1 Introduction

For more than a century, initial public offerings (IPOs) have attracted investors.[1] However, it took some time until the first academic studies on return patterns were published in the late 1960s. Ibbotson (1975) was the first to systematically investigate return patterns of several hundred IPOs. The most striking result surely was the significant positive average initial return. As a consequence, dozens of articles presented various rationales for setting the offer price lower than its "true" value. For this reason the underpricing of IPOs is one of the more frequently examined topics in finance literature. The papers of the earlier 1980s focused on whether and how underpricing can be used to overcome problems[2] caused by information asymmetry between the subjects involved in the process of going public (i. e. entrepreneurs, investment banks, investors). In the 1990s the analysis of reasons for underpricing was more diverse. The following classification of models (in Section 2) distinguishes between models that are explicitly based on information asymmetry and others that are not.

Section 2 is followed by an introduction of a completely new approach to explain

[1] In 1882, the readers of the Journal of the Royal Statistical Society were informed that there took place "such events during the past year as a great number of new issues — new shares in fact, coming forth in a great rush in the spring and summer months". After the turn of the century, the Economist reported about "'sky rocketing' propensities of various new [...] shares [...]" (29.12.1928, p. 1220).

[2] In extreme cases information asymmetry can lead to a complete halt of market activity, cf. Akerlof (1970).

underpricing. In Section 3, we argue that underpricing triggers public awareness of the company, which can in turn raise the operating performance and thus the firm value. This leads to a Nash equilibrium between company owners and investors. The latter profit from high underpricing, the former are able to internalize part of the increased company value by conducting a seasoned offering. The publicity function — which is crucial to our model — will be introduced analytically in a straightforward informationally symmetrical setting in Section 3.1, before we discuss the main assumptions in Section 3.2. Section 3.3 sums up central implications of our model, one of which is tested empirically in Section 4 The paper ends with a summary and an outlook (Section 5).

2 Literature Overview

2.1 Models explicitly based on Information Asymmetry

Since some market participants are equipped with superior information, reality is not characterized by symmetric information. This may lead to a complete market collapse.[3] The types of information asymmetry the literature has focused on are diverse. Some models investigate a situation where entrepreneurs are better informed about their company than investors are. Other models view investors as a group that is better informed about the secondary market price in contrast to investment banks. Yet other models assume an information asymmetry within the group of investors. Some models[4] in academic literature focus on underpricing as a means of *signaling*. In these models, high quality companies that toy with the idea to go public cannot credibly communicate their true value to investors. In a two-period offering process, where the IPO is followed by a seasoned offering, it is favorable for the companies to underprice and thus signal their quality to the investors. As without underpricing, low quality firms can pool with good quality companies in order to achieve equally high offering proceeds. Between the two periods, though, the real quality is revealed with positive probability. As a result, low quality firms get low proceeds at the secondary offering whereas high quality companies receive the higher value. Underpricing can serve as an effective signal for the firms' quality as it prohibitively raises the cost of detection for low quality companies. Accordingly, these are forced to admit their true type. Welch (1989) shows that, under certain conditions, an optimal level of underpricing exists.

As Allen and Faulhaber (1989, p. 305) point out, "firms typically can signal their quality with several variables other than the offer price". Some authors have inves-

[3] This was described by e. g. Akerlof (1970).

[4] Cf. e. g. Welch (1989), Allen and Faulhaber (1989) or Grinblatt and Hwang (1989).

tigated the influence of the *investment bank's reputation* as a signal for the level of underpricing. A higher reputation leads to an increase of the investors' confidence in the company's value. Consequently, a lower level of underpricing is required to attract the investors' interest in participating in the IPO, if the investment bank has a good reputation. The company itself cannot credibly publish information because of its proneness to moral hazard. The reason is that firms usually pass an IPO only once. The firm may omit material or publish colored or even wrong information in order to maximize proceeds. By contrast, investment banks usually participate in several IPOs, as that is one of their core businesses. As Beatty and Ritter (1986) indicate, two conditions have to be met so that investment banks are employed as intermediary. First, there has to be ex ante uncertainty about the secondary market price — otherwise the price is fixed at exactly the secondary market price, and no underpricing is necessary.[5] Second, the investment bank's reputation has to suffer if there are significant deviations of the secondary market price from the offer price. As Beatty and Ritter (1986, p. 226, Table 3a) show, investment banks with bad reputation face severe losses in terms of market share. In addition to this quantitative indication, Fassin and Lewis (1994, p. 54) allude to the positive correlation between reputation and margins. There is thus empirical evidence that both conditions hold in reality. However, not every investment bank can credibly signal a company's true value to the same degree. Well known and long established investment banks are trusted more than newcomers that lack a decent track record.[6]

Carter and Manaster (1990) have presented an ordinal scale (the "CM-ranking") which shows the relative level of reputation of each investment bank. Each investment bank's ranking depends on the relative position on so-called tombstone announcements.[7] So investors are able to distinguish between good and bad firms[8] just by referring to the level of the investment bank's reputation. Carter and Manaster (1990) show that a mutual selection equilibrium exists where both investment banks and companies opt for the "best" partner: Good firms choose highly respected investment banks, bad companies commission investment banks with a low CM-ranking number. Consequently, investment banks function as an effective signal to investors because good companies need to underprice only slightly whereas others have to give a significant financial incentive in order to make investors participate in the IPO.

As mentioned earlier, entrepreneurs cannot credibly communicate information about the intrinsic value of their firm, but various signals can effectively be employed to

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[5] As is obvious, even with high-effort evaluation there cannot be certainty about the future market price — if alone because of the time-lag between the fixing of the price and the first listing.

[6] If there is no reputation to be lost, an incentive problem can appear.

[7] Cf. Carter and Manaster (1990, p. 1054) or Brealey and Myers (2000, p. 413).

[8] In this context, "good firm" stands for "firm bearing little risk".

reduce the information asymmetry between entrepreneurs and investors. Chemmanur (1993) draws attention to the possibility that investors can directly produce information themselves. Accordingly, there is no necessity to employ such a signal. It must be externals (i. e. others than insiders) that publish information on the company in order to improve the investors' estimate about the companies value. If there are no externals (e. g. analysts) that engage in costly *information production*, all available information remains private and is not incorporated into the secondary market price.[9] If a high number of skilled externals produce any kind of information, the company will be valued at its intrinsic value. For high-value companies, it pays therefore to make e. g. analysts gather much information on the company. In order to implement incentives for external information production, there must be compensation for the associated costs. One means of offering this incentive to externals is underpricing.

Likewise, Benveniste and Spindt (1989) use the framework of an information production model to explain underpricing. However, they assume the group of investors[10] to be better informed about the secondary market price than the investment banks. In order to extract the knowledge that investors have about the future secondary market price, the investment banks conduct a *premarket auction* where they offer the shares to investors. Two preconditions have to be fulfilled. First, the price has to be significantly lower than the firm's value in order to encourage investors to give an indication of their interest. Second, the strategy to deliberately indicate lower interest in order to achieve a further reduction of the price must be inferior to investors. Due to the indication of interest the offer price is fixed at a level where the complete offer can be sold. Underpricing thus helps to alleviate the information asymmetry and enables an efficiently functioning market.

Undoubtedly, one of the most influential models[11] has been presented by Rock (1986). Its setting rests on the information asymmetry between informed and uninformed investors. Informed investors only participate in those offerings that promise to earn positive initial returns. The assumption seems plausible, for it is in fact more difficult to participate in successful offerings than in unsuccessful offerings. As Rock assumes, the group of informed investors does not have sufficient funds to fully subscribe the offering. In contrast, uninformed investors have a negative expected initial return if new offerings are not underpriced on average. Thus, underpricing is needed to compensate uninformed investors for the *winner's curse* and allow a successful allocation of all shares.

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[9] Cf. Fama (1970).

[10] Instead of the firm owners, as it was the case in the models presented so far.

[11] Cf. e. g. Ibbotson and Ritter (1995, p. 995).

2.2 Models not explicitly involving Information Asymmetry

The second class of models does not explicitly deal with information asymmetry.[12] The evaluation and determination of the offering price can be delegated to the investment bank. Nevertheless, the bank might still decide not to carry out the costly due-diligence investigation. However, there are both economic and legal obligations in order to prevent this. As to the latter, Section 11 of the Securities Act 1933 of the US requires investment banks to perform a due-diligence investigation and disclosure of the "affairs of the issuer that may affect a potential investor".[13] Any violation in the sense of false, inadequate and omitted material information can be subject of a *law suit*. The implicit[14] and explicit[15] costs "can be substantial".[16] However, only in cases where the secondary market price falls below the primary market price, the investment bank is likely to be subject of an investigation and a law suit. Tinic (1988) argues that firms use underpricing as a preventive means to reduce this risk.[17]

Under the threat of law suits as well as in Rock's model, negative initial returns lead to adverse effects. One means to avoid this is underpricing. Several authors have recently referred to another, more efficient measure — *stabilization*. Stabilization is an a posteriori means of buying shares if and only if they trade below their offer price.[18] Instead of letting all investors benefit a priori by lowering the price, the investment bank compensates only those investors who have purchased a bad performer. This does not imply, however, that there are no positive initial returns. As prices cannot be predicted, there are both positive and negative deviations. Because stabilization purchases prevent prices from falling below the IPO level, returns are positive on average.

Another explanation for underpricing has been presented by Welch (1993). In the model, he assumes a highly *elastic demand*, which can lead either to drastic over-subscription or to a complete failure of the IPO. Underpricing raises the likelihood of the former. Investors as a group have definite information about the expected

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[12] It should be noted that under symmetric information and fixed firm value, there is no reason for underpricing, as firm owners would sell and investors would buy the IPO at the known secondary market price. Therefore, all of the following models do take information asymmetry into consideration implicitly. Cf. also Kaserer and Kempf (1995, p. 4).

[13] Cf. Tinic (1988).

[14] As examples, take management time, negative publicity, loss of reputation etc.

[15] As examples, take lawyers, fines etc.

[16] Cf. Tinic (1988, p. 798).

[17] Insurance against law suits — if existent at all — has prohibitively high charges.

[18] Section 10b of the 1933 Securities Act of the US allows to carry out purchases as long as the share price is below the offer price.

secondary market price. However, they can hardly spread the information among themselves before the IPO has taken place and their combined pool of information culminates in a concrete market price.

Elastic demand is a consequence of *sales cascades*. These occur because each investor only holds a fraction of the aggregated investors' information — he adjusts his information to the interest indicated by investors who have approached earlier. Any additional piece of information from other investors improves the prediction of the investors about the future market price. The interest to participate in the listing sales procedure serves as an indicator for the type of information, be it positive or negative. If the first investor already has indicated his interest to buy, the second investor considers this positive indication and orders more shares than his personal information would have justified. The next potential investor bases his decision even to a larger degree on the interest indicated by the previous investors instead of only on his personal information. The more investors participate in the sequential sales procedure, the more elastically the demand curve reacts to changes of the first approaching investors. If they indicate interest, the demand is high, otherwise the probability of a failure increases. Welch (1993) shows that underpricing is an effective means to motivate early potential investors to show positive interest and thus to make the offering successful.

Among various other explanations, the *monopsony power hypothesis* assumes that investment banks use their market power to indirectly increase their rents. In a firm commitment contract, the investment bank purchases all shares of the company and bears the risk of insufficient demand. If, however, the investment bank reduces the offer price significantly, it sells all shares and enjoys a higher profit.

The *wealth redistribution hypothesis*[19] claims that previously state-owned, now privatized companies have been heavily underpriced and preferredly allocated to politicians involved in the privatization process. In Great Britain, companies like British Steel have been sold at significantly reduced prices in order to increase the likelihood of a successful reelection of the government. The *ownership dispersion hypothesis* assumes that it is not the owners, but the management that prefers underpricing. The argument is that high underpricing leads to oversubscription, and the management can more or less choose the new firm owners. If there are a lot of small shareholders, this reduces the influence of large-scale investors on the management.

[19] Cf. Ibbotson and Ritter (1995, p. 1000).

3 A New Explanation for the Amount of Underpricing: The Value Increasing Publicity Effect

3.1 An Introduction to the Model

A company that achieves a significant above average initial return on its IPO will attract due attention of analysts and media. Consequently, further investors are getting informed about the company and its business. As the individuals may not only appear as investors but also as consumers, they are more likely to purchase the products of the company in question than without this attention. This leads to an improved operating performance and ergo to a higher market capitalization. Entrepreneurs may internalize this by carrying out a seasoned offering.

Most of the yet existing models[20] on the underpricing of IPOs are based on the existence of a fixed value of the company. This value can be calculated by discounting expected free cash flow or expected dividends, in general discounted operating performance of the company. This "true" value is known by the agents or can be found out by some of them by a due-diligence investigation. However, it does not depend on the process and the statistics of the IPO. There are, however, good reasons why future cash flows of enterprises do depend on the process of the IPO. This is especially the case if the potential investors at the IPO are also potential customers of the enterprise.

We propose a bidirectional interrelation between the stock market and the company. The key innovation of the model is that the share price is affected by the company's value, and vice versa. The argumentation rests on the fact that an outstanding going public generates publicity which — for certain companies — functions as advertisement and in the end raises the operating performance.[21] The model contains a new and not yet investigated rationale for the underpricing of certain IPOs.

Underpricing in order to profit from publicity effects applies to different firms to a varying extent. There may be many reasons for this, the most important of which are made explicit in the following section. The model should *definitely not* be viewed as the sole explanation for underpricing. It must be seen in combination with other models and can then explain a part of the varying extent of underpricing.

[20] For an overview cf. Section 1 of this work.

[21] High operation performance may be caused by high cash flows, cf. Jain and Kini (1994).

3.2 A Story and Basic Assumptions

Let us motivate model and assumptions with an opening story. Suppose you want to order a book via internet. Imagine there is a company selling books via internet, called e. g. *tomes.com*. Imagine *tomes.com* has carried out an IPO recently, which has resulted in underpricing and large above average profits for the investors. Therefore, *tomes.com* has been mentioned in the news now and again.

Assumption 1 *The business press reacts positively on high underpricing.*

In Chemmanur (1993), externals are induced to produce information about the company. The lower the offer price is set the more information actually is produced.[22] Furthermore, some studies[23] have shown that new share offers displaying more significant underpricing attract a higher number of analysts who investigate the business situation of the company. The amount of information actually produced no doubt depends on several factors, especially the size of the company. If it is only a small start-up firm, the interest shown by analysts is limited to those specialized on this particular business, whereas larger companies channel more interest. It should be born in mind, however, that the effect for a small company is much higher even if in absolute terms the publicity is not far-reaching. A second determinant is the performance of the share relative to other companies. Only if the performance both in absolute and relative terms is significantly above average, there may be a publicity effect as specified here.

Back to the story: You remember the name of *tomes.com*, and thus get easily to the company's home page. You quickly find the book you want, order it, and *tomes.com* has won a new customer.

There are two main reasons for people to become customers of *tomes.com*. First, if people want to order their first book via internet, they better have a company's internet address in mind.[24] Second, people must believe that the company is trustworthy. The company can generate these circumstances e. g. by advertising, which is costly. However, advertising increases sales numbers as well as the number of customers. This in turn would lead to a rise in the value of the company, if advertising could be obtained "for free".

Assumption 2 *The company value reacts positively on publicity, especially on free publicity.*

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[22] However, information production is subject to certain restrictions, cf. Chemmanur (1993, p. 289).

[23] Cf. e. g. Rajan and Servaes (1997, p. 508) or O'Brien and Bhushan (1990).

[24] At least, they succeed faster if they already know a companies address. If they already know a firm, they will probably refrain from looking for yet another firm via search machine.

The information produced and gathered by analysts and other professionals is dispersed by the media: internet, newspapers, magazines, television etc., and thus creates an improved brand recognition by other less involved investors and the public in general. In finance, analysts are opinion leaders for uninformed investors and influence the kind of information about the company and its products investors are supplied with. Irvine (2001) shows that, in fact, the trading volume[25] has risen massively after analysts had commented on a particular company. The rather abstract term of "brand awareness" can be split into several more precise notions. Brand awareness exists when customers have a certain association with the brand. This might be only vague, superficial knowledge ("knowing the name", level 1), and an idea of the industry the company operates in (level 2). Consumers might also know their products (level 3) and its specifications (level 4). The deeper the insight into the company's business, the higher is the level of involvement and the more likely is an actual purchase of one of the products. As is likely, quite a substantial number of people — both professionals, investors and the public in general — make associations with the brand name, less people know the products the company offers.[26] In order to achieve a positive influence on the purchase decision of consumers, the association must have a positive quality. In general, share price appreciations lead to such a positive coupling. The improved operating performance[27] then leads to a higher market capitalization.[28]

Note that Assumption 2 does not hold to the same degree for all companies. Whereas internet firms profit from public fame, there seems to be no reason why mechanical engineering companies that produce rolling mills should profit at all. In addition, new small firms might profit to a higher degree compared to established ones, because if established firms already are known in the public, the further effect of press publicity might turn out to be only small.

Assumption 3 *The business press does not only reach potential investors, but also potential customers of the company, which leads to "free" advertisement via free publicity.*

Individuals not only take action as investors, but also as customers of the company. This assumption may especially be true to countries with a strong investment cul-

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[25] In this context, trading volume is interpreted as a proxy for the response of investors to analyst's publications.

[26] This is one reason why more and more companies — especially companies involved in internet business — choose their name equal to the product they have on offer. They simply take advantage of the high number of people associating the company's name and at the same time knowing the crucial product. However, there are also well known exceptions, like e. g. *yahoo.com* or *amazon.com*.

[27] Measured by the number of customers or turnover figures.

[28] Fama (1970) proved that semi-strong form efficiency holds.

ture, like nowadays the US and the UK, the Netherlands or Germany, to name only a few. In these countries, investment news reach a broad social stratum and are discussed widely. Otherwise there would not be significant spill-over-effects from capital markets to consumers. Note that Assumption 3 comprises the customers' bounded rationality. The source of information incompleteness is thus "shifted" from financial markets to sales markets.

3.3 A Formalization of the Model and Implications

Let us start with describing the agents of the model formally. First, there is the owner, who wants to sell his company. He does so by selling a part $0 \leq \alpha \leq 1$ via IPO for a price per share of $P \in \mathbb{R}_+$. The remaining part $1-\alpha$, he sells after the IPO at the stock markets[29] for the market price Y, which in equilibrium is equal to the firms value V. The owner maximizes the sum of the IPOs and the stock market's proceeds, $\alpha P + (1-\alpha)V$. The owner acts rationally, he takes into account all available information as well as the expected behaviour and reaction of investors and press. The owner's strategic variables are α and P.

Likewise, the investors are wealth maximizing and rational. They need not anticipate the owners behaviour, because the owners chosen strategy (α, P) is already known before the IPO. There is no information asymmetry between owner, investors and press.[30] All they have to anticipate is the press' reaction. Therefore, they buy the whole issue of the IPO if and only if $P \leq Y$ with $Y = V$ in equilibrium.

The IPO of a firm leads to publicity. The amount of publicity[31] A is simply an anticipation and reaction on the IPOs' statistics, α, P and V, as described in Assumption 3. We write

$$A = A(\alpha, P, V). \tag{1}$$

We assume that A depends only on the amount of underpricing V/P, and on the fraction of the company's equity on offer at the IPO, αP times the number of shares. As the number of shares is a constant, though, one can write $A = A(\alpha P, V/P)$. The firm value V in turn depends on the amount of publicity A,

$$V = V_0 + f(A), \tag{2}$$

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[29] Because of the complete information symmetry, there is no need to distinguish between a sale of the share on the stock market or via a seasoned offering.

[30] Because of the perfect information symmetry on the stock markets, the only reason for underpricing will be the jump of the firm's publicity. By contrast, the goods markets, where the firm sells its products, is characterized by either information asymmetry or irrationality. The demand function for products does react on additional information, such as publicity.

[31] We write A, because the publicity can be seen as "free" advertisement.

where V_0 is the value of the firm without the publicity triggered by the IPO.[32]

Let us now describe the exact temporal structure of the model. There are only two periods. In t_0, the owner announces the IPO's variables α and P. Investors react by buying or not buying the IPO. They buy if and only if they believe that V will be greater than P. In t_1, the shares are traded at the stock market, the price jumps to V. As no action is possible between t_0 and t_1, we can assume $t_0 \approx t_1$ and therefore ignore the effect of interest rates. After t_1, the remaining share $1-\alpha$ is sold at the already anticipated price V.

We want to prove the possibility of underpricing even in a world of perfect information symmetry. The absence of information asymmetry simplifies the model, because there is no need for an investment bank without information asymmetry, as the interests of investment bank and owner would be identical.

Although all investors have identical information, it is not obvious whether all of them believe in the same future value V and choose the same reaction on (α, P) in t_1. The reason is that there might be several values V that are consistent with α and P: It might be argued that if investors believe that there will be little advertisement effect, then they will believe the firm value is going to be low, which indeed leads to a moderate press reaction. If investors assume a high press reaction, they pay high prices at the stock markets, which in turn leads to high underpricing and therefore extensive press reaction. Briefly, the investors' anticipation of press reaction might be a self fulfilling prophecy, a disagreement of beliefs might occur.

However, under weak and appealing assumptions, one can prove that a unique future firm value V exists which is consistent with the IPO's statistics α and P, and which is believed by all investors.

Proposition 1 *Assume f and A are twice differentiable, and that $f' > 0$, $f'' < 0$, $A_2 > 0$ and $A_{22} < 0$ everywhere.*[33] *Then there exists exactly one firm value $V \in \mathbb{R}$ for which*

$$V = V_0 + f(A(\alpha P, \frac{V}{P})). \tag{3}$$

Let us first discuss the assumptions and then present the proof. As A is the amount of advertisement triggered by underpricing, it is natural to assume that A rises with increasing underpricing V/P, but with a decreasing slope. If advertisement is useful for the firm at all, it is natural to assume that the possibility of a "free" publicity of

[32] Therefore, $f(A=0) = 0$. As V is assumed to depend on A only, A contains all effect of the IPO's course on the firm value, e. g. the possible effect that investors contented by high underpricing might be prone to become the firm's customers, too.

[33] Let $A_1(x,y)$ denote the derivative of $A(x,y)$ regarding the first variable, $\frac{\partial}{\partial x}A(x,y)$, $A_{11}(x,y)$ the second derivative regarding the first variable, and so forth.

A increases the firm value, and therefore $f' > 0$. On the other hand, the marginal effect of publicity is decreasing, $f'' < 0$. One might think of a maximum firm value that cannot be increased any further only for reasons of "free" publicity.

Proof: Assume α and P are known, and investors believe in a firm value of V. This leads to an advertisement effect of $A(\alpha\, P, \frac{V}{P})$, which again leads to a possibly different firm value $F(V) := V_0 + f(A(\alpha\, P, \frac{V}{P}))$. We are thus looking for an equilibrium/a fixed point of (3),[34], where expected and true value V are equal. Taking derivatives yields[35]

$$F'(V) = f'(A) \cdot A_1 \cdot \frac{1}{P} \quad \text{and} \tag{4}$$

$$F''(V) = \left(f''(A) \cdot {A_2}^2 + f'(A) \cdot A_{22}\right) \frac{1}{P^2} \tag{5}$$

In (4), all factors are positive because of the assumptions, therefore $F'(V)$ is positive as well. However, $F''(V)$ is negative everywhere, because in the sum in (5) there is always exactly one negative factor. Therefore, and because $F(0) \geq V_0 > 0$, F cannot intersect the bisector of the angle more than once.[36]

Suppose F does not intersect the bisector at all. Then $\lim_{V\to\infty} F(V) = \infty$. Then A is bounded and A_2 converges against 0. This implies that F must intersect the bisector, which completes the proof. ■

Because the solution of (3) is unique, one can write $V(\alpha, P) = V_0 + \tilde{f}(\alpha, P)$,[37] and on this value all investors will agree. The group of investors can be seen as homogeneous, and the dynamic game is reduced to an action-reaction-game: The firm owner acts by choosing α and P, the group of investors react as one player first with buying the offering or not, then with setting a V.

The owner, anticipating P, must always choose $P \leq V$, otherwise he would be left with his shares. Without the value increasing publicity effect, the owner would implement $P = V$ or $\alpha = 0$. In the following, we examine the conditions under which the owners incentives make him choose $P < V$ and $\alpha > 0$.

Proposition 2 *In addition to the assumptions of Proposition 1, assume that*

$$f'(A)\, A_2 < P \text{ and} \tag{6}$$

$$\alpha\, P\, A_1 > \frac{V}{P}\, A_2 \tag{7}$$

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[34] The problem of disagreement of beliefs arises if there are several fix points.

[35] To simplify notation, we write A instead of $A(\alpha\, P, \frac{V}{P})$.

[36] This can be proven formally using Rolle's lemma.

[37] $\tilde{f}$ depends the functional forms of f and A only.

everywhere. Then the owner will choose $\alpha^* > 0$ *and* $P^* < V(\alpha^*, P^*)$*, which leads to abnormal returns on the first day of trade.*

Again, we will discuss the additional assumptions before furnishing the proof. Equation (6) is true when we assume that the effect of a change of value V on f via publicity A is less than the change of value itself, because then $d(f(A))/dV = f'(A)A_2/P < 1$. Equation (7) is a less natural assumption. In a certain sense, it implies that the effects (on A) of increasing the size of sold share αP on publicity exceed the effect of decreasing the underpricing V/P.[38]

Proof: The owner wants to maximize his gains

$$\max_{0\le\alpha\le 1,\, 0\le P\le V(\alpha,P)} \{\alpha P + (1-\alpha) V(\alpha, P)\}. \tag{8}$$

Therefore, he must solve the problem

$$\frac{\partial}{\partial \alpha}\{\alpha P + (1-\alpha) V(\alpha, P)\} = P + (1-\alpha)V_1(\alpha, P) - V(\alpha, P) = 0 \quad \text{and} \tag{9}$$

$$\frac{\partial}{\partial P}\{\alpha P + (1-\alpha) V(\alpha, P)\} = \alpha + (1-\alpha)V_2(\alpha, P) = 0. \tag{10}$$

Suppose $V_2 > 0$, then any α^* solving (10) must lie in the open interval $(0, 1)$. Suppose $V_1 > 0$, then $0 < \alpha^* < 1$ and (9) imply $V(P^*, \alpha^*) - P^* = (1-\alpha)V_2(\alpha, P) > 0$.

We still have to prove $V_2 > 0$ and $V_1 > 0$. Using the implicit function theorem, one derives

$$V_1(\alpha, P) = \frac{P^2 f'(A) A_1}{P - f'(A) A_2} \quad \text{and} \tag{11}$$

$$V_2(\alpha, P) = \frac{f'(A)(P^2 \alpha A_1 - V A_2)}{P(P - f'(A) A_2)} \quad \text{everywhere.} \tag{12}$$

The assumptions imply that numerator and denominator in (11) and (12) are positive, which completes the proof. ■

One can now derive a result on how underpricing depends on advertisement sensitivity.

Corollary 1 *A higher publicity sensitivity* $f'(A)$ *leads to a higher underpricing* V/P *and a higher* α*, if the functional form of* A *stays unchanged.*

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[38] A different assumption, which would lead to similar results, would be a publicity effect if and only if the IPO's turnover would lie over a predefined minimum level and therefore $\alpha \ge \alpha_{\min}$ for some $0 < \alpha_{\min} < 1$. We have to restrict the form of A in some way. If one thinks of an A independent of α, then the owner could maximize his proceeds simply by setting $\alpha = 0$ and $P = 0$. One avoids this effect by claiming (7).

Proof: We will only present an informal proof. In the equilibrium, equations (9), (10), (11) and (12) hold, which implies that

$$\alpha = \frac{f'(A)\,A_2(1+f'(A)\,A_1)}{V} \quad \text{and} \quad \frac{V}{P} = 1 + f'(A)\,A_1.$$

Informally argued, an increase of $f'(A)$ leads to an increase of α and V/P, which in turn affects all variables, and thus $A(\alpha\,P, V/P)$. This leads to a new equilibrium. However, the secondary effect cannot compensate the primary. ■

As a special case, one derives that $f \equiv 0$ and therefore $V = V_0$ implies $\alpha = 0$ and $P = V$. The model, concentrating only on the value increasing publicity effect, implies that the amount of underpricing depends only the functions f and A. Corollary 1 is an implication of the model that can be tested empirically. What one needs is a proxy for f' and the assumption that A is the same for all firms of all industrial sectors. In the following section, the association between f' and V/P is tested.

4 Empirical Results

Intuitively, the turnovers of different enterprises vary in their reactions on publicity for the enterprise. There is, however, no straightforward measure for this reaction, data on functional form of f[39] is difficult to obtain. In the following, we will therefore refrain from trying to determine the exact functional forms of f, A and V. Instead, we will test an implication of our model, Corollary 1, empirically. Let us describe in the following the procedure chosen.

The data has been obtained from the Frankfurt Stock Exchange and contains the IPO data of 269 firms, i. e. all the issues between March 10, 1997 and December 31, 1999. The data consist of the name and industrial sector of the firm, the volume of the issue, the issuing price, the price of the first trading day and others.

The idea to estimate a firm's sensitivity to publicity, we use the opinions of "experts". At the banking department of the University of Münster, there is a weekly workshop for asset management. The participating students usually discuss market events repeatedly, more often than once a week. In addition, they usually manage their private portfolios. Therefore, they know a considerable number of the 269 enterprises. We have sent them questionnaires containing only the issuing date, name and industrial sector of the firms as well as the request:

> Please answer for each of the enterprise's the following question: Do you think that the enterprises' turnover reacts on its degree of fame?

[39] f is defined implicitly in (2) on page 10.

> As a negative example take a mechanical engineering enterprise, whose turnovers in the extreme case do not depend at all on whether the enterprise is well-known or not. As a positive example, take an internet bookstore, whose turnovers one would expect to depend strongly on the degree of public fame.[40] Please select marks between '4' (strong dependence) and '0' (no dependence at all), if you do not know, please select 'D'. Please do not take into account any information you have on the IPO or the performance data. Thank you!

At first sight, questioning as a means to obtain proxies for financial data may not seem a sound practice. However, in the model introduced above, investors know a firm's dependence on public fame. A firm's value is driven by its dependence on public fame, whereas the price of its shares is driven by the investors' assessment of this dependence. It is thus of minor relevance whether the dependence itself or the investors' assessment are included in the empirical analysis.

16 questionnaires have been dispatched, 11 of them have been returned. One student forgot to fill half of the questionnaire, because he ignored that the questionnaires were printed double-sided. To sum up, the filled questionnaires contain 2006 marks from '0' through '4', 827 default entries 'D' and 137 forgotten marks. Of course, we used the entries of all of the students for regression. The average underpricing for the data is 42.076%, with a standard deviation of 64.50%. The students rated 51.03% of the firms on average, the median mark is '2', the upper and lower quartile are '3' and '1'.[41] We have taken the quotient between the issuing price and the price at the first trading day as an estimate for V/P, the students' marks as an estimate for $f'(A)$. Some descriptive statistics of the returned questionnaires can be taken from Table 1.

There is some structure to be found in Table 1. The average underpricing varies between the sectors of industry, as do the marks assigned by the respondents. E. g., 64.2% of the respondents that have rated 'Industry' have distributed a mark lower or equal to 2, compared to only 16.0% for the sector 'Trade'. Closer inspection leads to the suspicion that average underpricing may be negatively correlated to the sample distribution functions of marks at the points 0, 1, 2 and 3. Table 2 contains Kendall's τ between average underpricing and distribution functions of marks. The negativity (and relatively high significance) of correlation coefficients τ suggests a strong influence of the sector of industry on underpricing.

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[40] The aim of including an example in the request is to make it unmistakable. We feel that a firm's public fame and a firm's dependence on public fame may are two notions that may easily be mixed. However, one might argue that the example influences the respondents. As we control for the firms' sector of industry in the empirical evaluation, this potential influencing does not affect the results.

[41] As marks are only cardinal quantities, the calculation of mean and standard deviation is meaningless for them.

Table 1: Descriptive Statistics for the Sample

Sector	#	$\overline{[V/P]}$	Mks	$\hat{F}(0)$	$\hat{F}(1)$	$\hat{F}(2)$	$\hat{F}(3)$	$\hat{F}(4)$
B & F	26	51.5%	7.92	7.8%	19.9%	39.3%	86.4%	100.0%
Industry	55	18.8%	7.51	18.6%	64.2%	91.3%	99.5%	100.0%
IT	92	48.5%	7.15	1.5%	31.9%	74.2%	93.3%	100.0%
Media	31	59.7%	8.06	3.6%	30.8%	64.0%	86.4%	100.0%
Biotech.	19	22.7%	8.05	20.9%	58.8%	90.2%	99.3%	100.0%
Services	20	34.8%	6.65	3.8%	33.1%	60.9%	90.2%	100.0%
Telecomm.	11	59.0%	8.18	3.3%	24.4%	45.6%	73.3%	100.0%
Trade	15	49.5%	8.33	1.6%	16.0%	33.6%	52.0%	100.0%
total	269	42.3%	7.54	7.6%	37.9%	69.4%	89.8%	100.0%

Note: 'B&F' stands for banking and finance, 'Industry' for industry and mechanical engineering, 'IT' for information technology, 'Biotech.' for pharmacy and biotechnology, 'Telecomm.' for telecommunication. '#' denotes the number of firms in the sample, $\overline{[V/P]}$ the average underpricing, 'Mks' the number of marked firms, '$\hat{F}(0)$' to '$\hat{F}(4)$' the number of marks below the corresponding figure. Of course, $\hat{F}(4) = 100\%$, because '4' is the highest permissible mark.

Table 2: Kendall's τ between Underpricing (average within sector of industry) and Marks (distribution within sector of industry)

τ	$\hat{F}(0)$	$\hat{F}(1)$	$\hat{F}(2)$	$\hat{F}(3)$
$\overline{[V/P]}$	-26.6% (16.1%)	-57.1% (2.4%)	-42.9% (6.9%)	-64.3% (1.3%)

Note: These correlation coefficients reflect the influence of the sector of industry only. Negative coefficients indicate that sectors with high underpricing receive low marks on average. The numbers in brackets are the corresponding P-values.

Let us now first examine the association between marks and underpricing alone, controlling for sector of industry later. Table 3 contains Kendall's τ between the marks and the underpricing of the sample. The cardinality of the marks calls for the consideration of nonparametric measures of correlation only. We have chosen Kendall's τ, because it imposes very few assumptions on the properties of the data, and because it can easily be extended to a control for further parameters.[42] As different respondents may use different scales of marks, the marks of two respondents may not be comparable. This has been taken into account by controlling for respondents. Additionally, the rank correlations τ from the data of each respondent alone are listed in Table 3. As one can see, correlations as well as significance differ between respondents. For four respondents, the correlation is significant even at a 99% level of significance. From the aggregated marks (still controlling for the respondent), a τ of 11.04% is calculated, with a P-value of $0.0^{12}547$.

[42] Cf. Torgerson (1956).

Table 3: τ between $[V/P]$ and $[f'(a)]$, not Controlling for Sector of Industry

Resp.	Marks	τ	P
1	127	15.67%	0.5%
2	179	8.05%	5.5%
3	110	25.75%	0.0%
4	252	6.55%	6.1%
5	54	9.92%	14.6%
6	65	6.49%	22.4%
7	258	4.65%	13.3%
8	262	17.18%	0.0%
9	203	10.04%	1.7%
10	251	15.34%	0.0%
11	267	10.00%	0.7%
tot.	2028	11.04%	0.0%

'Resp.' stands for respondent, 'Marks' is the number of answers from the corresponding respondent, 'tot.' stands for data regarding the total sample. τ denotes Kendall's τ, P stands for corresponding P-values.

Accordingly, the results strongly support the hypothesis that underpricing and sensitivity to public fame are correlated. However, as an association between the sector of industry and underpricing has been corroborated in Table 1 (third column), it is not clear whether considering sensitivity to public fame can contribute a further share towards explaining underpricing.[43] Therefore, we control for the sector of industry in Table 4.

Comparing Table 3 and 4 leads to the following observations. *First*, in all but one cases the correlations τ have decreased. This stands to reason, because the sector of industry already has some capacity to explain different levels of underpricing. *Second*, P-values have decreased, leaving behind τ's that are (mainly) positive for each respondent — but at no reasonable level of significance. *Third*, the τ for the total sample is significantly positive. Hence, taking into account the sensitivity to public fame increases the explanatory power of the model, even when the sector of industry is controlled for.

In summary, half of the total rank correlation between underpricing and sensitivity to public fame is already contained in the varying average underpricing of different sectors of industry. Sensitivity to public fame has significant additional explanatory power. However, the reduced rank correlation when controlling for sector of industry need not be interpreted as a drawback for the model of Section 3. Because the reason for varying underpricing between different sectors of industry is not yet understood,

[43] Additionally, as already stated in footnote 40, the formulation of the request may certainly have influenced the respondents. This effect alone may have caused the correlation in Table 3.

Table 4: τ between $[V/P]$ and $[f'(a)]$, Controlling for Sector of Industry

Resp.	Marks	τ	P
1	127	3.35%	31.8%
2	179	0.70%	45.2%
3	110	11.41%	6.6%
4	252	5.44%	14.3%
5	54	10.26%	19.0%
6	65	-0.58%	52.3%
7	258	1.77%	36.0%
8	262	8.87%	3.7%
9	203	7.09%	10.7%
10	251	7.84%	6.0%
11	267	5.18%	14.4%
tot.	2028	5.63%	0.1%

'Resp.' stands for respondent, 'Marks' is the number of answers from the corresponding respondent, 'tot.' stands for data regarding the total sample. τ denotes Kendall's τ, P stands for corresponding P-values.

the model of Section 3 can be seen as a first step towards a theoretical explanation: Sectors with high sensitivity to public fame are distinguished by high underpricing.

5 Summary and Outlook

The proposed model shows that it may be rational — under certain assumptions — for some companies to heavily underprice an IPO in order to generate information production and as a result publicity. A higher level of brand recognition leads to higher operating figures and intrinsic value. Accordingly, the stock exchange actually influences the value of the company. This effect has not been looked at in previous models.

The keener enterprises are on public fame, the more likely they are to underprice their IPO in order to trigger or support this fame. This implication of the model has been tested empirically by means of a questioning of (potential) investors. The tests are significantly compatible with the model. Even the varying average underpricing of different sectors of industry may be explained by the firm's varying keenness on public fame.

The idea of a firm value that depends on the process of underpricing itself opens a large field of research possibilities. Let us sketch two areas of potential further research.

1. Section 4 contains only a rudimentary empirical result on the validity of the

model's predictions. Instead of evaluating questionnaires, it would be appealing to find hard data (e. g. volume and impact of advertising, increase of media hits after the IPO, ...) as a proxy for a firm's publicity sensitivity. This procedure might also allow to estimate the extent of the change of underpricing, and to prove whether considering the effect in a firm's financial strategy is worth the effort.

2. It would be interesting to check if and how the idea of a firm value dependent on the IPO process, e. g. because of the value increasing publicity effect, can be combined with the already existing models that explain underpricing. For some types of information asymmetry, the amount of underpricing might change, whereas one might be able to prove stability of the results for other types of information asymmetry. It would especially be of interest to examine how the value increasing publicity effect depends on the amount of information asymmetry.

In summary, the proposed model establishes a new idea to the theory of underpricing. The empirical analysis suggests the validity of the model, but sufficient scope for improvements remains.

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