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# Valuing and pricing IPOs

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**Abstract**

This paper investigates how underwriters set the IPO firm's fair value, an ex-ante estimate of the market value, using a unique dataset of 228 reports from French underwriters. These reports are issued before the IPO shares start trading on the stock market and detail how underwriters determined fair value. We document that underwriters often employ multiples valuation, dividend discount models and discounted cash flow (DCF) analysis to determine fair value but that all of these valuation methods suffer from a positive bias with respect to equilibrium market value.We also analyze how this fair value estimate is subsequently used as a basis for IPO pricing. We report that underwriters deliberately discount the fair value estimate when setting the preliminary offer price. Part of the intentional price discount can be recovered by higher price updates. We find that, controlling for other factors such as investor demand, part of underpricing stems from this intentional price discount.

*JEL classification:* G24; G32
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## 1. Introduction

An Initial Public Offering (IPO) is beset by price discovery problems. Issuers therefore hire an investment bank to underwrite the securities issue (Baron, 1982). Since underwriters are repeat players in the new issues market, they have an incentive to certify that the offer price reflects all available and relevant inside information about past and future payoffs (Ibbotson and Ritter, 1995). In this paper, we investigate how French underwriters set the IPO firm'sfair value, an ex-ante estimate of the market value,using a dataset of hand-collected underwriter reports. Moreover, we analyze how this fair value estimate is subsequently used as a basis for IPO pricing.

We obtain reports from underwriters that give us detailed valuation analyses for a sample of 228 IPOs on NYSE Euronext Paris during the years 1990-1999. These underwriter reports are issued before the shares start to trade on the stock market and are typically sent to investors together with the preliminary IPO prospectus. Unlike previous U.S. studies, this allows us to assess the pre-IPO valuation process used by investment bankers in practice. Moreover, we have access to unique data since cash flow forecasts of U.S. IPO firms are generally unavailable in SEC documents (Kaplan and Ruback, 1995). Specifically, underwriters in the United States can only comment on the valuation and provide earnings estimates after the quiet period of 25 calendar days after the IPO date has expired (Bradley et al., 2003).

This paper makes two importantcontributions to the literature. The first contribution is thatwe compare the bias, accuracy and explainabilityof threecommonequity valuation techniques used by underwriters: multiples valuation,dividend discount model valuation and discounted cash flow (DCF) valuation. This differs from Kim and Ritter (1999) andPurnanandam and Swaminathan (2004) who only consider the use of multiples valuation

and do not have access to pre-IPO reports that detail how underwriters exactly value the companies they bring public.

The second contribution of this paper is that we observe the intentional price discount that underwriters apply to arrive at the preliminary offer price before investor participation in the pricing process.Existing theories on IPO underpricing are based on issuers deliberately selling shares below their fair value to encourage investor participation and price discovery (e.g., Rock, 1986; Benveniste and Spindt, 1989; Shiller, 1990). However, empirically it is difficult to measure which part of IPO underpricing is due to deliberately setting offer prices too low (Shiller, 1990).Wetake a first step in this direction. Unlike previous studies this allows us to investigate to which degree the intentional price discount contributes to IPO underpricing after controlling for other factors such as investor demand.

Our results show that underwriters often use multiples valuation, dividend discount models and discounted cash flow models to determine fair value. We find that these three valuation techniques have similar bias, accuracy and explainability. Underwriters deliberately discount the fair value estimate when setting the preliminary offer price. Underwriters advertize this price discount in an attempt to augment investor participation in the auction or bookbuilding process. This results in higher price updates of the preliminary offer price that partially recover the discount. However, there is not a full adjustment but only a partial recovery of the intentional price discount. Consistent with the partial adjustment phenomenon part of the deliberate price discount remains and contributes to higher underpricing after controlling for other factors such as investor demand.

The outline of our paper is as follows. Section two briefly reviews the existing literature and positions our paper. Section three describes our data. Section four presents the results. Section five concludes.

## 2. Prior literature

The valuation of IPOs has received limited attention in the literature. Kim and Ritter (1999) investigate how the offer prices of U.S. IPO firms are set by selecting multiples from recent IPOs of firms from the same industry. They report that forward price-earnings multiples dominate all other multiples in valuation accuracy, and that the earnings per share forecast for next year dominates the use of current year earnings. Purnanandam and Swaminathan (2004) take a similar approach and find the median U.S. IPO firm is overvalued by about 50% relative to its industry peers. Houston et al. (2006) study the target prices established by analysts one month after the IPO and argue that this indicates how U.S. investment bankers value IPOs. They infer that offer prices are set at a discount of 10 percent compared to the mean comparable firm multiple used to set the target price one month later. However, this discount is not significantly different from zero.

The above studies focus on multiples valuation and ignore the other valuation techniques such as discounted cash flow (DCF) valuation that underwriters use in practice (Mills, 2005). A notable exception is offered by Kaplan and Ruback (1995) who compare the performance of the discounted cash flow estimates to that of estimates obtained from valuation approaches that rely on companies in similar industries and companies involved in similar transactions. The discounted cash flow methods, individually, perform at least as well as the comparable methods. However, their findings should be interpreted with caution since they are only able to retrieve cash flow forecasts for eight IPOs that previously completed highly leveraged transactions.

Our study adds to thisliterature because it makes use of a large sample of underwriter reports that are published before rather than after the IPO. In contrast to Houston et al. (2006), we therefore do not need to assume that ex-post valuations of analysts are

representative of how underwriters value IPOs ex-ante. In addition, previous IPO valuation studies (Kim and Ritter, 1999; Purnanandam and Swaminathan, 2004) estimate the value of IPO firms using their own techniques and focus on multiples valuation. These studies assume that their results approximate the valuation process used by the underwriter. However,Liu et al. (2002) argue that the use of these algorithms could diminish the performance of multiples valuation, since the researcher selects comparable firms in a mechanical way. In contrast, underwriters may select comparable firms more carefully and take into account situation-specific factors not considered by researchers (Ritter and Welch, 2002). Moreover, underwriters do not limit themselves to multiples valuation but generally also perform a discounted cash flow (DCF) analysis of some form (Mills, 2005; Roosenboom, 2007). Our study takes a different approach and analyzes both direct and relative valuation approaches that are widely used by underwriters in practice.

After valuing the IPO the shares need to be priced. The IPO pricing process begins after setting the preliminary offer price. The underwriter starts with canvassing investor demand for the shares during a road show or an auction. Any positive information about investor demand is used to adjust the preliminary offer price upward to arrive at the final offer price. However, in order to induce investors to truthfully reveal their private demand schedules the underwriter only partially adjusts the offer price, thus underpricing the shares to reward investors for revealing favorable private information (Benveniste and Spindt, 1989). This partial adjustment phenomenon has been widely documented in the United States (Hanley, 1993; Ritter and Welch, 2002) and internationally (Derrien and Womack, 2003; Ljungqvist et al., 2003).

Nevertheless IPO underpricing remains a puzzle. In their review,Ritter and Welch (2002) conclude that IPO underpricing is unlikely to be explained by simple fundamental market misevaluation or asset-pricing risk premia since it is unclear why investors that buy

the shares on the first day of trading would require such a premium whereas investors on the second day would no longer demand it. They also doubt whether IPO underpricing can be understood by an equilibrium compensation for private information revelationas suggested by Benveniste and Spindt (1989). Ritter and Welch(2002, page 1803) conclude that "the solution to the underpricing puzzle has to lie in focusing on the setting of the offer price".Shiller (1990) also argues that looking at the setting of the offer price is important. His survey results show thatmost IPO investors do not extensively research the companies they invest in but instead rely on the reputation of the underwriter to certify fundamental value.

In this paper, we explore this reason for IPO underpricing, namely that underwriters apply an intentional price discount to their fair value estimate of IPO shares when setting the preliminary offer price (Shiller, 1990; Roosenboom, 2007). Such a deliberate discount allows underwriters to expend less market effort and to ingratiate themselves with buy-side clients such as institutional investors (Baron, 1982) and increase investor demand above the level it would normally have been (Shiller, 1990).Because the issuer cannot monitor the underwriter without cost they trust the underwriters' pricing decision and consider IPOunderpricing as a necessary cost of going public. This argument has not been tested in the existing literature because it requires data access to the intentional price discount.Our paper aims to fill this gap and investigates whether underwriters intentionally discount their fair value estimate to induce investors to reveal their private information in the pricing process. We then investigate to which degree the deliberate price discount explains IPO underpricing controlling for other factors including investors' demand.

## 3. Data and sample description

### *3.1. Sample construction*

We identify all newly listed firms from January 1990 to December 1999 from *L'AnnéeBoursière*, an annual publication of the *Société des Bourses Françaises* (SBF), and the *SDC New Issues Database*. Table 1 shows our selection criteria.We do not include 24 firms that listed on the *Premier Marché* (the most prestigious listing venue in France) because these mostly involve privatization, equity carve-outs or spin-offs. We also exclude 29 firms that transfer from the *Marché hors-cote* (an over-the-counter market that existed until 1998), or that previously traded on a foreign stock market because these firms already had a price established for their shares such that price discovery is simple. For the same reason, 18 firms that listed either on one of the six regional stock exchanges (Bordeaux, Lille, Lyon, Marseille, Nantes, and Nancy) or on the *Marché Libre*(an unregulated trading platform in France) are excluded. Finally, weremove 26 financial services firms (SIC codes 6000-6999) because their financial statement information is not comparable to that of other firms.

This results in a sample of 309 non-financial French firms that had an IPO on the *Nouveau Marché* (98 firms) or the *Second Marché* (211 firms) of Euronext Paris.[1] We obtain valuation reports from the issuer, from the lead underwriter, from the *Commission des Opération de Bourse* (COB), i.e. the French equivalent of the Securities and Exchange Commission (SEC), or from *Thomson Research*for 228 out of 309 companies. The valuation reports are issued by 34 different underwriters.

[Please insert Table 1 about here]

[1]The *Nouveau Marché* was established in 1996 to attract young and high-tech issuers. Companies that wanted to list on this stock marketwere required to have a book value of equity equal to €1.5 million and to raise a minimum of €5 million in the IPO. At least half of the shares sold in the IPO had to be newly issued by the company. In addition, *Nouveau Marché* IPO firms wererequired to have a free float equal to at least 20% of the shares outstanding after the IPO. The *Second Marché*was founded in 1983 to attract small family-run businesses in more mature industries. Firms that went public on this stock market hadto exist for at least two years and have a free float of at least 10% of the shares outstanding after the IPO. Both the *Nouveau Marché*and*Second Marché*do not exist anymore since 2005.

*3.2. Firm and offer characteristics*

We first examine the industry distribution for our sample of 228 IPO firms (not tabulated). We classify our firms into Fama and French (1997) industries. Our sample consists of many different industries of which business services (22.8%), wholesale trade (9.2%) and retail (5.7%) are the most important. We identify technology firms following the approach of Loughran and Ritter (2004).[2] We observe that 22.8% of our sample firms are active in the technology sector.

[Please insert Table 2 about here]

Table 2 tabulates the firm and offer characteristics. Offer prices and financial statement numbers are derived from IPO prospectuses. We collect information about total assets from the balance sheet ending one financial year before the IPO. Average [median] total assets equals€56 million [€20.9 million]. Company age is measured as the number of years the firm has been in existence prior to its IPO. The average [median] age equals 27.4 years [16 years].Plant, property and equipmentconstitutean average [median] of 17.9% [13.4%] of the company's assets in the financial year before the IPO.

Table 2 also reports on the forecasted profitability defined as the current year's forecasted earnings before interest and taxes divided by current year's forecasted sales. The average [median] profitability equals 11% [10.5%]. Only 10 out of 228 sample companies are forecasted to report losses in the current year. Our analysis is therefore not dominated by loss

[2] High-tech companies are active in SIC codes 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3674 (semiconductors), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 3841, 3845 (medical instruments), 4812, 4813 (telephone equipment), 4899 (communications services) and 7370, 7371, 7372, 7373, 7374, 7375, 7378 and 7379 (software). We collect SIC codes from *COMPUSTATGlobal Vantage* and *Worldscope Disclosure*.

making companies. Next, we examine forecasted sales growth during the current year. The average [median] company in our sample is expected to experience a sales growth of 31% [21.4%]. French companies that go public typically announce their intended dividend policy in their IPO prospectus. We find that the average [median] company plans to pay out 20% [20%] of its net income.

We now turn to the offer characteristics. We calculate the underwriter market share as the percentage market share of the lead underwriter. Following Ljungqvist and Wilhelm (2002), market share is the sum of gross proceeds (excluding over-allotment option) in all IPOs lead managed by the underwriter divided by the total proceeds raised during the year of the IPO.[3]We use the underwriter market share as a proxy for the underwriter's reputation capital. The average [median] market share of the lead underwriter is 4.8% [0.6%]. The average [median] dilution factor, defined as the number of newly issued shares divided by the number of pre-IPO shares outstanding, equals 13.9% [11.1%].The average [median] participation ratio, defined as the number of existing shares sold by pre-IPO shareholders divided by the number of pre-IPO shares, is 11.1% [10%]. As a final point, we determine IPO proceeds as the number of shares sold in the IPO times the final offer price. Table 2 shows that the average [median] IPO proceeds equals€11.2million [€7 million].

*3.3.Valuation techniques used*

In this section, we describe the pre-IPO valuation process.[4] Figure 1 provides an overview. At the outset, the underwriter establishes a fair value estimate using one or more valuation

[3] We base the annual market share on the original sample of 309 companies that went public during 1990-1999. In unreported tests, we have also used the underwriter market share in the three years before the IPO year and the market share during the entire sample period taking into account name changes of underwriters because of mergers and acquisitions in the underwriting industry. We find similar results using these alternative measures of underwriter market share.

[4] A detailed description of the valuation techniques can be found in text books such as Penman (2001) and Damodaran (2002).

methods. The fair value estimate is viewed as an ex-ante estimate of the 'true' or market value of the IPO. Table 3 presents an overview of the valuation methods used to value the IPO firm's equity in our sample. We report that underwriters often use comparable firms/transactions multiples with this method being used in more than 87% of the cases. The most popular multiples are price-earnings ratios, followed by price-to-cash flow ratios, price-to-sales ratios and enterprise value ratios. Underwriters typically select comparable firms on the basis of industry and/or size. They calculate the estimated value by multiplying the average or median accounting-based multiple of the peer group with the corresponding accounting number of the IPO firm. Typically underwriters use forecasted accounting data for the current or next year when computing multiples. We find that the underwriter selects 6.3 comparable firms, on average (not in table). Transaction multiples are used to value 22 IPO firms. In those cases, underwriters use multiples paid in recent M&A or IPO transactions from the same industry. However, underwriters also frequently use other equity valuation methods. Table 3 shows that the dividend discount models are used to estimate the equity value of the IPO in 135 cases (59.2%). Table 3 also shows that there are 135 cases (59.2%) in whichthe discounted cash flow analysis is used to estimate the equity value of the IPO. This fraction is much higher than the use of discounted cash flow analysis among U.S. analysts and investment banks (DeAngelo, 1990; Asquith et al., 2005; Houston at al., 2006).

[Please insert Figure 1 and Table 3 about here]

We also document the use of economic value added valuation. We find that its use is not as widespread with 19.3% of underwriters employing this method. Underwriters sometimes base fair value estimates on underwriter-specific valuation techniques such as

discounting sales, discounting earnings, sum-of-the-parts valuation etc. These underwriter-specific techniques are used in 11.4% of the cases.

We also determine the conditional and unconditional weights underwriters apply to the estimated values of the different methods when arriving at their fair value estimate. The second column of Table 3 shows that multiples valuation is given the highest weight followed by the dividend discount model and the discounted cash flow model. The economic value added and underwriter-specific techniques play a minor role. The third column of Table 3 shows that among the different multiples, the price-earnings multiple is the most important one. In a typical underwriter report, the underwriter aggregates the value estimates of the different multiples together into one value estimate. In subsequent analyses we use this composite value estimate for reasons of brevity.

*3.4. Valuing and pricing IPOs*

The IPO valuation and pricing process starts with the fair value estimate, which serves as an ex-ante estimate of 'true' or market value [See Figure 1]. Table 4 shows that the underwriter estimates the average [median] fair value of the IPO firm's equity to be €71.7million [€41.2million]. Table 4 also shows the value estimates derived from the individual valuation methods. After the underwriter has determined the fair value estimate he applies a deliberate price discount to come to the preliminary offer value. Thisintentional price discount equals 18.2 percent both evaluated at the mean and the median. The deliberate price discount is often advertised in the underwriter report. For example: "The preliminary offer price offers a substantial discount from our fair value estimate. We therefore issue a strong buy recommendation for this stock".

[Please insert Table 4 about here]

Table 4 also shows that the average [median] preliminary offer value, computed as the preliminary offer price times the number of shares outstanding after completion of the IPO, equals €59.5 million [€33.9 million]. The preliminary offer price is calculated as the midpoint of price range in the case of 128 bookbuilt IPOs and equals the minimum tender price for 81 auctioned IPOs.[5] The preliminary prices are set before the underwriter learns about investor demand for the IPO. Our sample also contains 19 fixed-price offerings for which we set the preliminary offer price equal to the final offer price. On average, the minimum tender price for IPO auctions and the price range for bookbuilt IPOs are chosen two weeks before the shares start trading on the stock market (Ljungqvist and Wilhelm, 2002; Derrien and Womack, 2003). It is at about this time the underwriter reports are released. The fixed-price in fixed price offerings is set about one week before the IPO date.

As a next step, the underwriter collects information about investor demand for the shares. This new information is used to adjust the preliminary offer price to arrive at the final offer price. Table 4 reveals that this price update averages 4.6%. The average [median] final offer value, calculated as the final offer price times the number of shares after completion of the IPO, equals €61.6 million [€35.3 million].

In France, the quotation of the stock during the first trading day is suspended in case of a too large increase in the stock price (the market is said to be reserved) and trades can reopen only several days after the IPO day with a higher clearing price (Derrien and

[5] In France, firms can choose between different IPO selling mechanisms. The *Offre à Prix Minimal* (OPM) is a single-bid auction in which a minimum tender price is set beforehand. In a fixed-price offering or *Offre à Prix Ferme* (OPF) a fixed number of shares is offered at a fixed price. Since 1993, French IPOs can also be made through a placing or *Placement Garanti* (PG). This procedure corresponds to the bookbuilding procedure that is used in the United States. Since 1999 French issuers can also use a modified bookbuilding procedure called the *Offreà Prix Ouvert (OPO)* that allows them to reserve a fraction of the offered shares for retail investors (Derrien, 2005). Two of our sample firms use this modified bookbuilding mechanism. For a more detailed discussion of French IPO selling mechanisms we refer to Derrien and Womack (2003).

Womack, 2003).[6] Equilibrium market value is determined as the number of shares outstanding after the IPO times the market equilibrium price at which shares transact. The market equilibrium prices are provided by François Derrien and used in Derrien and Womack (2003) for the period 1992-1998 and from the NYSE Euronext Paris for the other years. The average [median] equilibrium market value equals €69.3 [€42.7 million]. This shows that the average market value is above the average final offer value. On average, investors therefore earn a return by paying a lower price for the stock than the full information equilibrium market price in the secondary trading market. The average [median] IPO underpricing equals 12.9% [7.6%].

## 4. Empirical results

### *4.1. Valuing IPOs*

In this section we document the bias, accuracy and explainability of the valuation methods applied by underwriters in our sample. This follows the approach of Francis et al. (2000) who argue that it is important to assess bias, accuracy as well as explainability of valuation methods.

#### *4.1.1. Signed prediction errors (bias)*

We first calculate signed prediction errors of each valuation method as the (estimated value-equilibrium market value)/equilibrium market value.[7] Assuming an efficient stock market,

[6] We thank an anonymous referee for this suggestion.

[7] Most valuation studies define prediction errors based on market values (e.g., Francis et al., 2000; Liu et al., 2002). We do not report prediction errors based on offer values because underwriters may simultaneously decide on the value estimate and the offer value. For example, underwriters may select comparable firms with

these prediction errors capture the bias associated with the different methods. Panel A of Table 5 shows that most methods are associated with positive average and median prediction errors that are significantly different from zero. We also observe that the fraction of observations with positive prediction errors exceeds 50% for all valuation methods.

[Please insert Table 5 about here]

Panel A reveals that the average [median] prediction error of the fair value estimate equals 8% [6.8%] with 66.2% of prediction errors being positive. This suggests that underwriters overestimate market values ex-ante. Comparing the different value methods we observe that thecomparable firms/transaction multiple method is the least biased valuation method. However, one problem with comparing the bias across methods is that certain valuation methods will be more appropriate than others. The underwriter decides which methods are appropriate to value the IPO stock and which are not. For example, the difference between the signed prediction error of the multiples method and the dividend discount model could be caused by companies for which the underwriter uses the multiples method but not the discounted dividend model.For the 120 firms where the underwriter uses both methods, the results might differ from those reported in Panel A. We therefore re-examine bias using a pairwise comparison of the three most important valuation methods (multiples, dividend discount models and discounted cash flow valuation). A drawback is that sample sizes are reduced. Panel B of Table 5 shows the results. We find that the average and median prediction error (bias) are not statistically different from each other.

high multiples if they desire high offer values and choose comparable firms with low multiples if they do not want the IPO to look overpriced (Kim and Ritter, 1999). More importantly, the prediction error would include the deliberate price discount that underwriters apply to the fair value estimate to set the offer value.

*4.1.2. Absolute prediction errors (accuracy)*

We also compute absolute prediction errors as |(estimated value- equilibrium market value)/equilibrium market value|. Absolute prediction errors measure the valuation accuracy of the different methods. We investigate central tendency defined as the percentage of observations with absolute prediction errors of 15% or less. This 15% threshold is widely used in the literature (Kaplan and Ruback, 1995; Kim and Ritter, 1999; Gilson et al., 2000). Panel A of Table 6 reveals that the multiples valuation method has the lowest average absolute prediction error and highest central tendency (i.e., highest accuracy) and the economic value added method has the highest average absolute prediction error and lowest central tendency (i.e., lowest valuation accuracy). In particular, the average absolute prediction errors range from 18.5% for the multiples method to 30.3% for the economic value added method. The average [median] accuracy of the fair value estimate equals 16.8% [12.4%].

[Please insert Table 6 about here]

Panel B of Table 6 shows the results of a pairwise comparison between the accuracy of the different valuation methods. It reveals no statistically significant differences in the absolute prediction errors (accuracy). We conclude that there are only few differences in the average and median accuracy across different valuation methods.This confirms the results of Kaplan and Ruback (1995) whoshow that the multiples approach and the discounted cash flow valuation perform equally well. However, theiranalysis excludes the dividend discount model and applies to a small sample of highly leveraged transactions in the United States and is therefore not strictly comparable to our large sample evidence on French IPOs.

*4.1.3. Valuation regressions (explainability)*

Besides bias and accuracy, we also examine explainability, defined as the ability of value estimates to explain cross-sectional variation in equilibrium market values. For this purpose we conduct a Wald-test to test the joint hypothesis that the intercept equals zero and the slope equals one. If the value estimates are unbiased predictors of market values, then the intercept should equal zero and the slope be one. We report the results in Table 7.

In the regression we regress the natural logarithm of the equilibrium market value on the natural logarithm of the value estimate. Table 7 shows that we cannot reject the hypothesis that the slope coefficient equals one for any of the valuation methods. However, the Wald-statistic shows that the joint hypothesis of an intercept equal to zero and a slope coefficient equal to one is rejected for all valuation methods as well as the fair value estimate. On the surface, none of valuation methodsor the fair value estimate therefore produces an unbiased estimate of market value. On inspection of the explanatory power of the different models, we find that the dividend discount model has highest explanatory power and the economic value added methodis associated with the lowest explanatory power.

[Please insert Tables 7 and 8 about here]

In Table 8 we investigate whether underwriters can improve their valuation estimate when using different valuation methods together. We limit ourselves to the three most popular techniques for which we have sufficient number of observations (multiples valuation, the dividend discount model and the discounted cash flow model). The incremental $R^2$ is the difference between the adjusted $R^2$ for the OLS regression containing both value estimates

and the adjusted $R^2$ for the OLS regression which excludes the valuation method in the noted column. We find that adding an additional method increases the explanatory power of the model significantly for all combinations.Nevertheless, the Wald-test continues to reject that the two methods together are producing an unbiased estimate of market value.

These results prompt the question why underwriters deliberately overestimate the fair value with respect to the equilibrium market value. We argue that one of the reasons underwriters engage in this behavior is because it enables them to offer a larger discount to investors. This predicts that more biased valuations are associated with higher price discounts. We indeed find a high correlation between the price discount and bias of the fair value estimate (i.e., signed prediction error) of 0.448. Next, we split the sample in three groups of low, medium and high bias fair value estimates (untabulated).[8] We find that low bias valuations (i.e., signed prediction error in the lowest tercile) are associated with significantly lower average [median] price discount of 15.2% [16.7%] than high bias valuations (i.e., signed prediction error in the highest tercile) with an average [median] price discount of 24% [23.3%]. This suggests that underwriters may bias valuations because it gives them the opportunity to subsequently offer higher discounts to investors.

*4.1.4.Cross-sectional regressions*

In this section we investigate whether cross-sectional differences in bias and accuracy across IPO firms can be related to the firm and offer characteristics discussed in section 3.2. We control for difference between the two market segments by including a *Nouveau Marché*dummy in the OLS regressions. We define a technology dummy that equals one if the

[8] Results are available upon request from the authors.

firm is active in the technology sector as defined by Loughran and Ritter (2004).Technology firms may be more difficult to value and it is therefore important to control for this. We also include the market return and market volatility during the 100 days before the underwriter report is published to control for stock market conditions.

Table 9 reports the results. More profitable IPO firms show less biased valuations. Higher reputation underwriters are associated with lower bias for most of the valuation methods. A one standard deviation increase in the market share of the underwriter reduces the bias in the fair value estimate by 4.7 percentage points. This reduction is substantial and makes up more than half of the average bias of the fair value estimate. Dilution is another key driver of bias. More biased valuations occur when companies are planning to sell a large number of newly issued shares. This suggests that underwriters are more biased in case issuers are raising more money in the IPO. Underwriters bias valuations less when market returns are higher during the 100 trading days before the publishing date of the underwriter report. Market volatility is associated with higher bias.

Columns 5 to 8 of Table 9 show the results for valuation accuracy. Note that a negative regression coefficient indicates higher accuracy (i.e. lower absolute prediction errors). Valuation accuracy is improved (i.e., the absolute prediction is error is lower) when issuers are older and underwriters have a higher reputation. Underwriters seem to more accurately value older companies with established track recordsbut are less accurate when the stock market is more volatile. There are no other firm and offer characteristicsbesides company age, underwriter reputation and pre-valuation market volatility that can consistently explain the cross-sectional variation in accuracy.

[Please insert Table 9 about here]

*4.2. Pricing IPOs*

In this section we investigate how the fair value estimate is used for subsequent IPO pricing. We have already documented that the underwriter deliberately applies a price discount to this fair value estimate when setting the preliminary offer price. We first investigate whether this deliberate price discount can be related to firm and offer characteristics and then see how this intentional price discount impacts price updates and underpricing.

*4.2.1. Intentional price discounts*

The first column of Table 10 shows that high reputation underwriters are associated with lower intentional price discounts. This can be explained by the fact that an underwriter with larger market share probably has a more extended network and access to a large pool of potential investors. They do not have to offer high discounts in order to get investors interested in buying shares in the IPO but use their reputation to certify the quality of the issuer (Carterand Manaster, 1990). The price discount is also lower for firms that are forecasted to be more profitable. Underwriters do not have to offer high discounts to interest investors inthe shares of IPO firms that are expected to show strong profitability in the future. Interestingly, ex-ante risk proxies such as firm age and the technology dummy turn out to be insignificant. This suggests that the intentional price discount is not primarily used to compensate investors for risk. None of the other firm and offer characteristics is significant. We also include a variable that measures the average absolute prediction errors (accuracy) of fair value estimates in the 100 trading days before the publishing date of theunderwriter report. This captures how accurate valuation techniques are in the past period. We find that underwriters discount the fair value estimate more when the average absolute prediction

errors were high in the 100 days before (i.e. accuracy was low). Underwriters therefore offer higher discounts at a time when valuation techniques generateless accurate value estimates.Market return and market volatility during the 100 trading days before the underwriter report was published do not significantly impact the price discount.

[Please insert Table 10 about here]

*4.2.2. Price updates*

The next step in the pricing process is that the underwriters collect information about investor demand for the IPO. If the underwriter learns positive information about investor demand this will result in a positive price update.Next to firm and offer characteristics we add two new variables. We measure the pre-pricing market return and the pre-pricing market volatility between the date the underwriter report was published and the date the final offer price was set. This information arrives after the publishing date of the underwriter report and therefore could not have been incorporated into the fair value estimate but is likely to impact the price update. The second column of Table 10 displays the results. We report that price updates are higher for companies with higher forecasted sales growth. Price updates are higher when stock market returns are higher and lower when the stock market index is more volatile. A unique feature of the French IPO market is that shares are sold via single-bid auctions(Derrien and Womack, 2003). There are 81 sample firms that go public via an auction. The auction dummy is significantly positive suggesting that auctions are associated with higher price updates. This confirms the results of Derrien and Womack (2003). More importantly, the intentional discount is positively related to the price update as well. This suggests that underwriters deliberately discount the fair value estimate in order to augment

investor demand. Investors are then more likely to bid up the price of the shares in the auction or bookbuilding procedure. Part of the discount can thus be recouped through higher price updates of the preliminary offer price. A one standard deviation increase in the intentional price discount increases the price update with 1.9 percentage points. This increase makes up more than 41 percent of the average price update.

*4.2.3. Underpricing*

The third column of Table 10 shows the results for the underpricing regression. We find that older companies are associated with lower levels of underpricing. Technology firms experience higher levels of underpricing. Other firm characteristics do not seem to significantly impact underpricing. Companies going public via auctions experience less underpricing as shown by Derrien and Womack (2003) before. Again we add two new variables that measure market return and market volatility but this time during the interval between the setting of the final offer price and the first day of trading. This information cannot be incorporated into the final offer price because it arrives afterwards. We find that underpricing is higher if the market return during this interval is higher.

Price updates are positively related to underpricing. This is consistent with the partial adjustment phenomenon first documented by Hanley (1993) and prior French evidence from Derrien and Womack (2003). Without partial adjustment investors have no incentive to disclose their private demand in the auction or bookbuildingprocedure because they know that showing an interest to buy IPO shares will drive up the offer price. This problem may be offset, if underwriters only partially adjust the offer price to positive information, as to reward investors with underpriced shares.

The intentional price discount also has a positive impact on underpricing. This suggests that part of underpricing is due to underwriters deliberately discounting the price to augment investor interest. Although part of the deliberate price discount is recouped by higher price updates it remains an important driver of underpricing. A one standard deviation increase in the deliberate price discount increases underpricing by 2.6 percentage points. This increase makes up 20 percent of the average underpricing. Other firm and offer characteristics are insignificant.

Part of underpricing therefore seems to be a compensation for investors to disclose their demand for IPO shares. Another part of underpricing can be attributed to an intentional price discount that occurs before any information about investor demand is collected. Underwriters use this intentional price discount to augment investor demand. This results in higher price updates that partially regain the discount. However, consistent with the partial adjustment phenomenon there is not a full adjustment. Part of the deliberate price discount remains and results in higher returns for investors. In column 4 of Table 10 we redefine underpricing as the percentage difference between the market capitalization 10 days after the equilibrium price has been established and the final offer value. We find similar results as before.

As a final point, we control for investors' demand in our underpricing regressions. Wemeasure investor demand by oversubscription rates (i.e., total shares demanded in the IPO/total shares that are sold in the IPO).[9] We have been able to collect information on

[9]Derrien (2005) usesindividual investor's oversubscription ratios to measure investor sentiment. However, individual investors' oversubscription ratios are only available for French IPO firms that use a modified bookbuilding procedure called the *Offreà Prix Ouvert (OPO*). We cannot use these individual investors' oversubscription ratios given that this IPO selling procedure was introduced in 1999 and only two of our sample firms use this procedure. We therefore use total investor demand as a proxy for investor sentiment in this paper. In unreported tests, we find that IPOs that are in the top tercile of oversubscription have lower average 2-year buy-and-hold abnormal returns (starting on the 11$^{th}$ trading day) than IPOs in the lower two terciles of oversubscription. However, there is no significant difference when we compare median buy-and-hold abnormal returns. IPOs that are in the top tercile of oversubscription also more frequently have an equilibrium market price above the fair value estimate of the underwriter. This suggests that oversubscription rates capture at least some part of investor sentiment.

oversubscription rates for a sample of 118 IPO firms. The average [median] oversubscription rate equals 30.9 [15]. Table 10, column (5) shows the results. We find that oversubscription rates are significantly and positively related to underpricing. A one standard deviation increase in the oversubscription rate increases underpricing by 6.3 percentage points, other things equal. In comparison, a one standard deviation increase in price discount contributes 2.9 percentage points to underpricing, other things equal.

*4.2.4. Robustness checks*

An obvious problem with our analysis is endogeneity. For example, the partial adjustment phenomenon suggests that price updates and underpricing should be estimated simultaneously, because the underwriter's pricing decision depends on how much money he has to leave on the table to ensure that investors truthfully reveal their demand for IPO shares during the auction or the pre-market phase of the bookbuilding process. Similar endogenous relationships can exist between the intentional price discount and the price update and the intentional price discount and underpricing. We therefore test for these potential endogeneity problems using the Davidson-MacKinnon (1993) test. This test can be formed by including the residuals of each endogenous right-hand side variable, as a function of all exogenous variables, in a regression of the original model and then testing whether the coefficient on the residuals are significantly different from zero. The test statistic indicates no evidence for an endogenous relation between underpricing and the intentional price discount ($p$-value=0.56), between underpricing and the price update ($p$-value=0.77) and between the price update and the intentional price discount ($p$-value=0.15). This indicates that the OLS regressions in section 4.2.3 produce consistent coefficient estimates.

We also repeat our entire analysis for the group of 81 auctioned IPOs and the group of 128 bookbuilt IPOs separately. We find qualitatively similar findings for both subsamples. We also split the sample into a companies going public on the *Nouveau Marché*and the*Second Marché*. We find similar results for both market segments.

## 5. Conclusions

This paper is one of the first to investigate how underwriters set the IPO firm's fair value, an ex-ante estimate of the market value, and how these underwriters subsequently use their fair value estimate as a basis for IPO pricing. We obtain a unique dataset consisting of 228 underwriter reports of IPO firms on NYSE Euronext Paris.Our results show that underwriters typically arrive at a fair value estimate by usingmultiples valuation, dividend discount models and discounted cash flow models to value the IPO firm.There is not one single valuation technique that stands out in being less positively biased or more accurate than the others.

Underwriters discount their biased fair value estimate to arrive at the preliminary offer value. These discounts are lower for higher reputation underwriters and, controlling for other factors, are associated with higher price updates. We find that the decision of the underwriter and issuer to offer price discountsis associated with higher underpricing.

We conclude that it is important to know how underwriters set offer prices in order to better understand why IPO underpricing exists. This corresponds to the view of Ritter and Welch (2002) who concludethat "the solution to the underpricing puzzle has to lie in focusing on the setting of the offer price" (page 1803).We take a first step in this direction and examine how underwriters value IPOs and set offer prices in practice. A key insight is that underwriters set preliminary offer prices by applying a discount to their fair market value estimate. This price discount is not fully recovered later in the valuation and pricing process

and therefore contributes to IPO underpricing. We also find that most underwriters do not exclusively rely on multiples valuation when valuing IPOs. This contrasts with the IPO literature that mostly studiesmultiples valuation (e.g. Kim and Ritter, 1999; Purnanandam and Swaminathan, 2004; Houston et al., 2006). Future research should therefore pay more attention to other widely used direct valuation methods such as discounted cash flow (DCF) analysis and how underwriters set offer prices.

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**Figure 1: IPO valuation and pricing process**

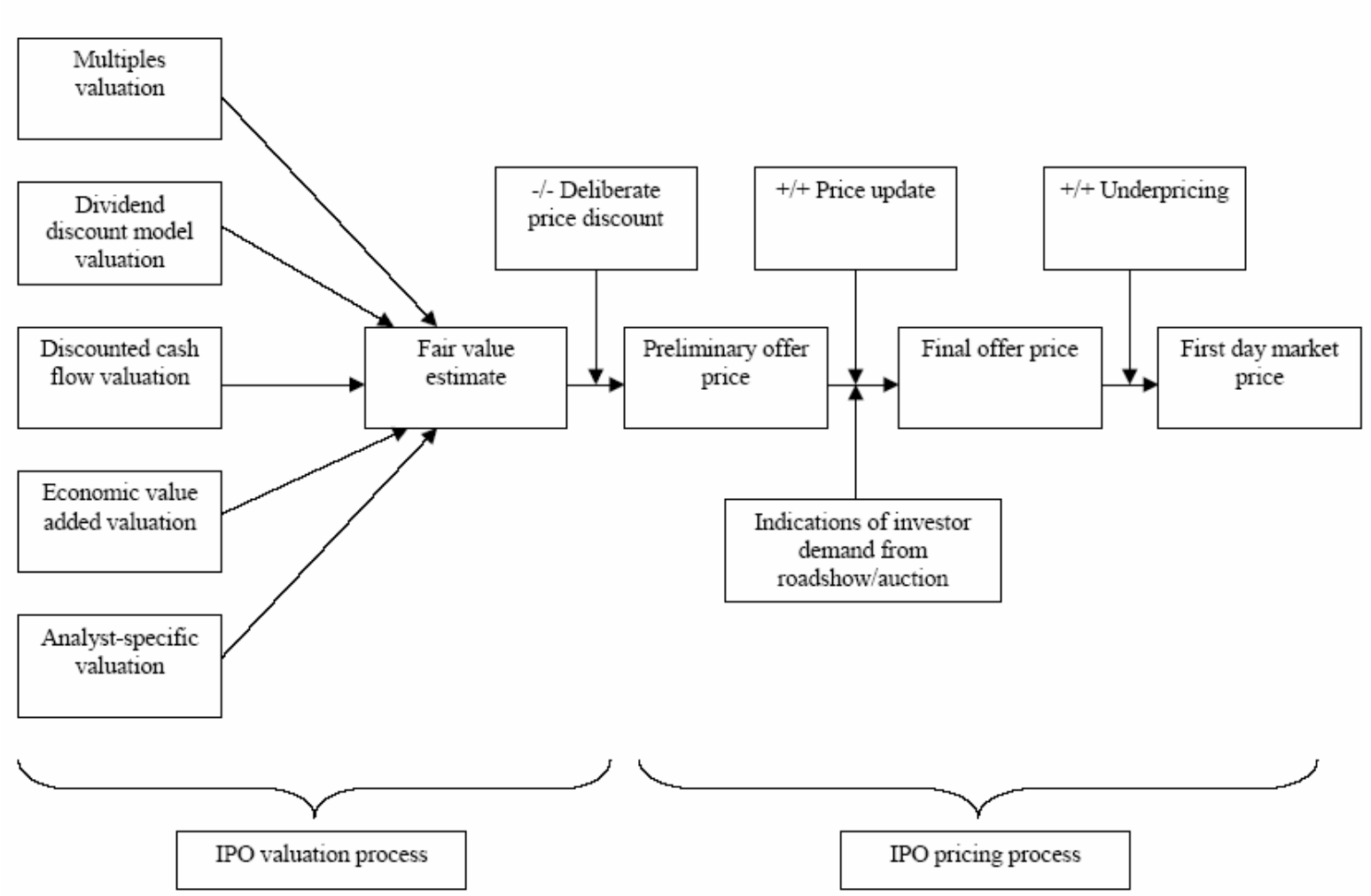

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**Table 1**
Sample selection criteria

| Year | Domestic universe | Exclusions because of | | | | | *In sample* |
|---|---|---|---|---|---|---|---|
| | | Premier Marché | Transfers | Financial services | Regional exchange | No underwriter coverage | |
| 1990 | 16 | 0 | 0 | 7 | 4 | 0 | 5 |
| 1991 | 14 | 2 | 0 | 6 | 3 | 0 | 3 |
| 1992 | 6 | 1 | 0 | 1 | 2 | 2 | 0 |
| 1993 | 9 | 0 | 0 | 2 | 0 | 0 | 7 |
| 1994 | 36 | 3 | 1 | 3 | 3 | 4 | 22 |
| 1995 | 21 | 3 | 4 | 1 | 0 | 1 | 12 |
| 1996 | 52 | 4 | 3 | 2 | 1 | 17 | 25 |
| 1997 | 66 | 2 | 7 | 2 | 2 | 16 | 37 |
| 1998 | 119 | 5 | 9 | 1 | 1 | 24 | 79 |
| 1999 | 67 | 4 | 5 | 1 | 2 | 17 | 38 |
| Total | 406 | 24 | 29 | 26 | 18 | 81 | 228 |

Note: We started with the complete universe of French newly listed firms from January 1990 to December 1999. New listings were identified by *L'AnnéeBoursière*, an annual publication of the *Société des Bourses Françaises* (SBF) and the *SDC New Issues Database*. We excluded 24 domestic firms that listed on the *Premier Marché* (the most prestigious listing venue in France), because they generally involved privatization, equity carve-outs or spin-offs. Twenty-nine firms that transferred from the *Marché hors-cote* (an over-the-counter market that existed until 1998), or that previously traded on a foreign stock market, are excluded because their price discovery is straightforward. We dropped 26 financial services firms (SIC codes 6000-6999) because their reporting environments are very different from those of other newly listed firms. For the same reason, 18 firms that listed either on one of the six regional stock exchanges (Bordeaux, Lille, Lyon, Marseille, Nantes, and Nancy) or on the *MarchéLibre*(an unregulated trading platform in France) were dropped. A total of 81 companies with no underwriter reports available were excluded as a final step. The filters resulted in a sample of 228 non-financial French firms that had an Initial Public Offering (IPO) on either the *Nouveau Marché* or the *Second Marché* of NYSE Euronext Paris.

**Table 2**
Firm and offer characteristics

| Variable | Mean | Min | *Percentiles* | | | Max | Std. dev. |
|---|---|---|---|---|---|---|---|
| | | | 25th | 50th | 75th | | |
| Total assets (millions €) | 55.97 | 1.76 | 10.79 | 20.92 | 52.08 | 903.63 | 98.86 |
| Company age (years) | 27.44 | 2.00 | 9.75 | 16.00 | 30.00 | 250.00 | 32.75 |
| Plant, property and equipment (%) | 17.91 | 0.21 | 5.41 | 13.38 | 25.33 | 84.55 | 16.37 |
| Profitability (%) | 10.99 | -32.51 | 7.30 | 10.50 | 15.51 | 48.92 | 8.86 |
| Sales growth (%) | 31.04 | -9.48 | 11.79 | 21.44 | 37.99 | 303.62 | 35.17 |
| Dividend policy (%) | 20.03 | 0.00 | 12.88 | 20.00 | 28.13 | 80.00 | 13.94 |
| Underwriter reputation (%) | 4.82 | 0.02 | 0.40 | 0.57 | 2.95 | 64.71 | 10.97 |
| Dilution factor (%) | 13.86 | 0.00 | 0.00 | 11.11 | 19.82 | 94.04 | 16.04 |
| Participation ratio (%) | 11.07 | 0.00 | 4.95 | 10.00 | 15.00 | 58.83 | 9.50 |
| Proceeds (millions €) | 11.18 | 1.32 | 4.62 | 7.03 | 12.93 | 88.56 | 12.24 |

Note: The sample consists of 228 IPO firms from January 1990 to December 1999. Total assets are for the last 12 months reported in the prospectus. Company age is the number of years the company has been in existence prior to its listing. Plant, property and equipment is for the last 12 months reported in the prospectus and expressed as a percentage of total assets. Profitability is defined as the current year's forecasted earnings before interest and taxes divided by the current year's forecasted sales as reported in the underwriter report. Sales growth is the forecasted sales growth during the current year and is taken from the underwriter report. Dividend policy is from the IPO prospectus and is defined as the percentage of net income the firm intends to pay out as dividends in the future. Underwriter market share is measured as the sum of gross proceeds (excluding over-allotment option) raised in all IPOs lead managed by the underwriter *j* divided by the total proceeds raised during the year of the IPO. The dilution factor is defined as the number of newly issued shares at the IPO divided by the number of pre-IPO shares outstanding. The participation ratio is computed as the number of existing shares sold by pre-IPO shareholders divided by the number of pre-IPO shares. Proceeds are calculated as the number of shares offered to the public times the final offer price. We use the French Consumer Price Index (CPI) from the World Bank's World Development Indicators (WDI) to express all money amounts in constant euro terms for the year 1999.

**Table 3**
Valuation techniques used by underwriters to value IPOs

| Valuation method | Percentage of underwriters using this method | Percentage of fair values based on this method | Percentage of fair values based on this method conditional on the underwriter using this method |
|---|---|---|---|
| Comparable firm/transactions multiples | 87.28 | 43.88 | 50.26 |
| Price-earnings ratio | 83.77 | 24.82 | 29.62 |
| Price-cash flow ratio | 41.23 | 5.63 | 13.65 |
| Price-sales ratio | 24.12 | 4.05 | 16.78 |
| Price-book ratio | 16.23 | 1.54 | 9.52 |
| Enterprise value-sales ratio | 24.56 | 3.00 | 12.21 |
| Enterprise value-earnings ratio | 24.56 | 4.27 | 17.38 |
| Other ratios | 7.02 | 0.57 | 8.08 |
| Dividend discount model | 59.21 | 23.92 | 40.41 |
| Discounted cash flow | 59.21 | 21.80 | 36.82 |
| Economic value added | 19.29 | 5.83 | 30.23 |
| Underwriter-specific techniques | 11.40 | 4.57 | 40.09 |

**Table 4**
Valuing and pricing IPOs

| Variable | Mean | Min | *Percentiles* | | | Max | Std. Dev. | N |
|---|---|---|---|---|---|---|---|---|
| | | | 25th | 50th | 75th | | | |
| Valuing IPOs (millions €) using: | | | | | | | | |
| Fair value estimate | 71.73 | 12.48 | 27.44 | 41.22 | 81.02 | 660.23 | 87.50 | 228 |
| Comparable firm/transactions multiples | 73.49 | 9.99 | 27.26 | 43.42 | 82.08 | 696.47 | 92.80 | 199 |
| Dividend discount model | 75.84 | 12.80 | 26.63 | 40.70 | 75.71 | 651.31 | 102.74 | 135 |
| Discounted cash flow | 61.54 | 13.67 | 28.65 | 41.10 | 66.20 | 435.84 | 59.92 | 135 |
| Economic value added | 52.22 | 14.10 | 30.24 | 40.14 | 63.47 | 237.06 | 40.56 | 44 |
| Underwriter-specific techniques | 63.70 | 14.98 | 28.08 | 35.41 | 70.25 | 341.62 | 69.90 | 26 |
| Pricing IPOs: | | | | | | | | |
| Deliberate price discount (%) | 18.21 | -9.09 | 12.92 | 18.21 | 24.57 | 50.94 | 9.86 | 228 |
| Preliminary offer value (millions €) | 59.45 | 10.92 | 21.97 | 33.90 | 66.82 | 598.40 | 74.38 | 228 |
| Price update (%) | 4.56 | -14.71 | 0.00 | 3.47 | 6.98 | 47.27 | 7.41 | 228 |
| Final offer value (millions €) | 61.59 | 10.75 | 23.00 | 35.32 | 67.87 | 598.40 | 75.43 | 228 |
| Equilibrium market value (millions €) | 69.31 | 10.97 | 24.45 | 42.70 | 72.88 | 660.21 | 84.48 | 228 |
| Underpricing (%) | 12.91 | -20.95 | 0 | 7.56 | 19.01 | 126.67 | 20.21 | 228 |

Note: Table shows the distribution of valuation and pricing variables. Sample sizes (N) vary depending on the particular valuation method(s) that the underwriter uses. Fair value estimate is taken from the underwriterreport and can be viewed as an ex-ante estimate of the market capitalization. The value estimates of the different valuation techniques are also hand-collected from underwriter reports. The deliberate price discount is computed as (fair value estimate – preliminary offer value)/fair value estimate. Preliminary offer value is computed as the number of shares outstanding after the IPO times the preliminary offer price. The preliminary offer price equals the midpoint of the price range for 128 IPOs that use the bookbuilding procedure. The preliminary offer price is set equal to the minimum tender price for 81 IPO auctions. The preliminary price equals the fixed-offer price for 19 fixed-price offerings. The price update is defined as (final offer value – preliminary offer value)/preliminary offer value.Final offer value is calculated as the number of shares outstanding after the IPO times the final offer price. Equilibrium market value is determined as the number of shares outstanding after the IPO times the market equilibrium price. The market equilibrium price is the first clearing price at which shares transact. The market equilibrium prices are provided by François Derrien and used in Derrien and Womack (2003) for the period 1992-1998 and fromNYSE Euronext Paris for the other years. Underpricing is calculated as (equilibrium market value – final offer value)/final offer value. We use the French Consumer Price Index (CPI) from the World Bank's World Development Indicators (WDI) to express all money amounts in constant euro terms for the year 1999.

**Table 5**
Signed prediction errors (bias)

*Panel A: Signed prediction errors (bias) per equity valuation method*

| Variable | Mean | Min | *Percentiles* | | | Max | Std.dev | % positive | N |
|---|---|---|---|---|---|---|---|---|---|
| | | | 25th | 50th | 75th | | | | |
| Comparable firm/transactions multiples (%) | 7.14[a] | -73.63 | -6.03 | 4.77[a] | 18.82 | 155.00 | 26.35 | 62.81 | 199 |
| Dividend discount model (%) | 11.83[a] | -38.52 | -2.86 | 9.60[a] | 20.11 | 167.96 | 27.81 | 64.44 | 135 |
| Discounted cash flow (%) | 11.44[a] | -41.03 | -5.46 | 8.07[a] | 27.18 | 81.25 | 24.54 | 67.41 | 135 |
| Economic value added (%) | 17.50[a] | -47.15 | -8.52 | 9.86[a] | 37.87 | 143.97 | 37.06 | 61.36 | 44 |
| Underwriter-specific techniques (%) | 18.28[a] | -39.12 | -1.82 | 10.25[b] | 33.80 | 115.09 | 33.34 | 61.53 | 26 |
| Fair value estimate (%) | 7.98[a] | -43.76 | -4.81 | 6.78[a] | 19.24 | 96.42 | 20.84 | 66.22 | 228 |

*Panel B: Pairwise comparisons between equity valuation methods*

| | Comparison between: | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Multiples (MUL) and dividend discount model (DDM) | | | | Multiples (MUL) and discounted cash flow (DCF) | | | | Discounted cash flow (DCF) and dividend discount model (DDM) | | | |
| | MUL | DDM | Test for diff. | N | MUL | DCF | Test for diff. | N | DCF | DDM | Test for diff. | N |
| Signed prediction error (bias, %) | 8.46 [5.17] | 11.62 [9.76] | -1.14 [0.64] | 120 | 10.22 [5.45] | 11.08 [8.60] | -0.31 [0.88] | 116 | 10.02 [8.41] | 16.46 [15.50] | -1.47 [0.61] | 64 |

Note:Signed prediction errors are measured in percent as (estimated value-equilibrium market value)/equilibrium market value. We test whether the average and median signed prediction error is statistically different from zero using a standard *t*-test for means and the Wilcoxon signed rank test for medians. In Panel B we conduct a pairwise comparison between the various equity valuation methods using samples of firms that are valued using the two particular equity valuation methods under consideration. We perform a *t*-test to test whether the differences in average bias are statistically significant. Medians are reported in brackets. We perform a nonparametric Wilcoxon-Mann-Whitney rank test to test for equality of medians.[a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on the particular valuation technique(s) that the underwriter uses.

**Table 6**
Absolute prediction errors (accuracy)

*Panel A: Absolute prediction errors (accuracy) per equity valuation method*

| | Mean | Min | *Percentiles* | | | Max | Std.dev | Central tendency (%) | N |
|---|---|---|---|---|---|---|---|---|---|
| | | | 25th | 50th | 75th | | | | |
| Comparable firm/transactions multiples (%) | 18.52[a] | 0.07 | 5.06 | 13.52[a] | 24.86 | 155.00 | 20.02 | 54.27 | 199 |
| Dividend discount model (%) | 19.86[a] | 0.16 | 6.45 | 14.86[a] | 23.60 | 167.96 | 22.75 | 50.37 | 135 |
| Discounted cash flow (%) | 20.86[a] | 0.26 | 7.66 | 14.64[a] | 30.02 | 81.25 | 17.21 | 51.11 | 135 |
| Economic value added (%) | 30.32[a] | 0.01 | 8.79 | 25.61[a] | 42.45 | 143.97 | 27.32 | 29.55 | 44 |
| Underwriter-specific techniques (%) | 25.64[b] | 0.81 | 6.26 | 17.24[a] | 34.89 | 115.09 | 27.85 | 50.00 | 26 |
| Fair value estimate (%) | 16.79[a] | 0.00 | 6.52 | 12.42[a] | 24.14 | 96.42 | 14.67 | 57.46 | 228 |

*Panel B: Pairwise comparisons between equity valuation methods*

| | Comparison between: | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Multiples (MUL) and dividend discount model (DDM) | | | | Multiples (MUL) and discounted cash flow (DCF) | | | | Discounted cash flow (DCF) and dividend discount model (DDM) | | | |
| | MUL | DDM | Test for diff. | N | MUL | DCF | Test for diff. | N | DCF | DDM | Test for diff. | N |
| Absolute prediction errors (accuracy, %) | 18.08 [13.63] | 20.04 [15.37] | -1.02 [0.93] | 120 | 21.50 [15.26] | 21.64 [17.22] | -0.06 [0.69] | 116 | 19.42 [13.83] | 24.67 [18.41] | -1.53 [1.00] | 64 |

Note: Absolute prediction errors are measured in percent as |(estimated value – equilibrium market value)/equilibrium market value|. Central tendency is percentage of observations with absolute prediction error of 15% or less. We test whether the average and median absolute prediction error is statistically different from zero using a standard *t*-test for means and the Wilcoxon signed rank test for medians. In Panel B we use samples of firms that are valued using the two particular equity valuation methods under consideration. We perform a *t*-test to test whether the differences in average accuracy are statistically significant. Medians are reported in brackets. We perform a nonparametric Wilcoxon-Mann-Whitney rank test to test for equality of medians.[a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on the particular valuation technique(s) that the underwriter uses.

**Table 7**
Univariate valuation regressions (explainability)

| Independent variable is estimated value using (see below): | *Parameter estimates* | | Adj. $R^2$ (%) | N | Wald-test |
|---|---|---|---|---|---|
| | Intercept | Slope | | | |
| Comparable firm/transactions multiples | 0.073<br>(0.750) | 0.971<br>(-1.250) | 91.04 | 199 | 4.70[b] |
| Dividend discount model | -0.026<br>(-0.303) | 0.985<br>(-0.705) | 93.03 | 135 | 10.06[a] |
| Discounted cash flow | -0.158<br>(-1.610) | 1.019<br>(0.761) | 91.24 | 135 | 9.95[a] |
| Economic value added | -0.351<br>(-1.385) | 1.063<br>(0.963) | 80.02 | 44 | 3.21[c] |
| Underwriter-specific techniques | -0.017<br>(-0.079) | 0.970<br>(-0.468) | 88.64 | 26 | 3.53[b] |
| Fair value estimate | -0.124<br>(-2.088)[b] | 1.017<br>(1.184) | 94.39 | 228 | 9.98[a] |

Note: OLS regressions with the natural log of the equilibrium market value as the dependent variable and the natural log of the estimated value using the different valuation methods as the independent variable. We use the French Consumer Price Index (CPI) from the World Bank's World Development Indicators (WDI) to express all money amounts in constant euro terms for the year 1999. The Wald-test tests the joint hypothesis that the intercept equals zero and the slope equals one. *t*-statistics using White (1980) heteroscedastic standard errors are in parentheses and test whether the intercept is statistically different from zero and the slope coefficient is statistically significant from one. [a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on the particular valuation technique(s) that the underwriter uses.

**Table 8**
Multivariate valuation regressions (explainability)

| Independent variables are value estimates using (see below): | Parameter estimates | | | Adj. $R^2$ (%) | Incr. $R^2$ (%)method (1) | Incr. $R^2$ (%)method (2) | N | Wald-test |
|---|---|---|---|---|---|---|---|---|
| | Intercept | Slope method (1) | Slope method (2) | | | | | |
| Comparable firm multiples (method 1) and dividend discount model (method 2) | -0.040 (-0.475) | 0.432 (-11.17)[a] | 0.560 (-7.85)[a] | 94.59 | 2.07 (46.14)[a] | 3.28 (72.55)[a] | 120 | 9.30[a] |
| Comparable firm multiples (method 1) and discounted cash flow model (method 2 | -0.184 (-1.772)[c] | 0.325 (-5.525)[a] | 0.704 (-2.509)[b] | 91.48 | 1.16 (16.49)[a] | 5.51 (74.71)[a] | 116 | 7.07[a] |
| Dividend discount model (method 1) and discounted cash flow model (method 2) | -0.097 (-0.813) | 0.358 (7.323)[a] | 0.643 (3.492)[a] | 93.06 | 1.43 (16.17)[a] | 5.04 (46.00)[a] | 64 | 6.99[a] |

Note: OLS regressions with the natural log of the equilibrium market value as the dependent variable and the natural log of the estimated value using the different valuation methods as the independent variables. We use the French Consumer Price Index (CPI) from the World Bank's World Development Indicators (WDI) to express all money amounts in constant euro terms for the year 1999. The Wald-test tests the joint hypothesis that the intercept equals zero and the sum of the slopes equals one. *t*-statistics using White (1980) heteroscedastic standard errors are in parentheses and test whether the intercept is statistically different from zero and the slope coefficients are statistically significant from one. We test whether the explanatory power of the model is increased by adding another valuation method. The incremental $R^2$ is the difference between the adjusted $R^2$ for the OLS regression containing both value estimates and the adjusted $R^2$ for the OLS regression which excludes the valuation method in the noted column. We test whether the increase in explanatory power is significant using a F-test. The F-statistic is reported in parentheses. [a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on the particular valuation technique(s) that the underwriter uses in combination.

**Table 9**
Valuing IPOs

| Column | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Dependent variable | Bias multiples | Bias dividend discount model | Bias discounted cash flow | Bias fair value estimate | Accuracy multiples | Accuracy dividend discount model | Accuracy discounted cash flow | Accuracy fair value estimate |
| Log(Total assets) | 0.020 | -0.011 | -0.020 | -0.003 | 0.002 | -0.021 | 0.002 | -0.001 |
| | (1.055) | (-0.395) | (-0.960) | (-0.020) | (0.097) | (-0.950) | (0.100) | (-0.136) |
| Log(1+company age) | -0.041 | -0.034 | 0.015 | -0.014 | -0.067 | -0.052 | -0.021 | -0.038 |
| | (-1.525) | (-1.288) | (0.481) | (-0.891) | (-3.337)[a] | (-2.333)[b] | (-1.672)[c] | (-3.106)[a] |
| Plant, property and equipment | -0.025 | -0.057 | 0.036 | 0.026 | -0.032 | -0.074 | -0.020 | -0.014 |
| | (-0.223) | (-0.410) | (0.313) | (0.326) | (-0.371) | (-0.808) | (-0.225) | (-0.254) |
| Profitability | -0.335 | -0.698 | -0.118 | -0.288 | -0.050 | -0.510 | 0.004 | -0.081 |
| | (-1.824)[c] | (-1.797)[c] | (-0.478) | (-1.685)[c] | (-0.324) | (-1.903)[c] | (0.024) | (-0.686) |
| Sales growth | -0.068 | -0.140 | -0.055 | -0.063 | -0.066 | -0.111 | -0.061 | -0.035 |
| | (-1.183) | (-1.598) | (-1.116) | (-1.423) | (-1.297) | (-1.401) | (-0.879) | (-1.082) |
| Dividend policy | 0.187 | -0.189 | -0.284 | 0.048 | -0.051 | -0.220 | 0.078 | -0.063 |
| | (1.508) | (-1.008) | (-1.433) | (1.484) | (-0.558) | (-1.327) | (0.573) | (-0.874) |
| Underwriter reputation | -0.748 | -0.027 | -0.655 | -0.425 | -0.493 | 0.390 | -0.428 | -0.411 |
| | (-2.511)[a] | (-0.034) | (-2.138)[b] | (-1.991)[b] | (-1.992)[b] | (0.554) | (-1.855)[c] | (-1.700)[c] |
| Dilution factor | 0.216 | 0.396 | 0.057 | 0.237 | 0.182 | 0.307 | 0.031 | 0.232 |
| | (1.742)[c] | (1.781)[c] | (0.470) | (1.687)[c] | (1.402) | (1.592) | (0.319) | (1.293) |
| Participation ratio | 0.385 | 0.380 | -0.091 | 0.146 | 0.303 | 0.206 | -0.001 | 0.102 |
| | (2.109)[b] | (1.351) | (-0.528) | (1.035) | (1.461) | (0.919) | (-0.002) | (1.071) |
| *Nouveau Marché* dummy | -0.055 | 0.086 | -0.025 | 0.026 | -0.071 | 0.088 | 0.024 | -0.024 |
| | (-0.963) | (0.657) | (-0.471) | (0.622) | (-1.412) | (0.776) | (0.673) | (-0.748) |
| Technology dummy | -0.063 | 0.008 | -0.034 | -0.075 | -0.009 | -0.055 | 0.068 | -0.026 |
| | (-1.361) | (0.113) | (-0.506) | (-1.443) | (-0.250) | (-0.892) | (1.526) | (-0.960) |
| Pre-valuation | -0.354 | -0.467 | -0.153 | -0.303 | -0.073 | -0.178 | -0.122 | -0.067 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| market return | (-2.807)[a] | (-2.986)[a] | (-1.107) | (-3.523)[a] | (-0.715) | (-1.412) | (-1.156) | (-1.037) |
| Pre-valuation | 12.219 | 7.021 | 24.600 | 11.917 | 2.847 | 0.324 | 10.033 | 5.969 |
| market volatility | (1.958)[c] | (0.931) | (3.370)[a] | (2.765)[a] | (0.555) | (0.050) | (1.754)[c] | (1.777)[c] |
| Intercept | 0.026 | 0.288 | -0.079 | 0.018 | 0.371 | 0.526 | 0.122 | 0.227 |
| | (0.186) | (1.587) | (-0.504) | (0.192) | (3.244)[a] | (3.679)[a] | (1.104) | (3.181)[a] |
| Adjusted $R^2$ | 0.132 | 0.180 | 0.163 | 0.185 | 0.025 | 0.161 | 0.062 | 0.108 |
| F-statistic | 3.319[a] | 3.261[a] | 3.006[a] | 4.958[a] | 1.387 | 2.982[a] | 1.687[c] | 3.119[a] |
| N | 199 | 135 | 135 | 228 | 199 | 135 | 135 | 228 |

Note: Table shows cross-sectional OLS regression results using bias and accuracy as dependent variables.*t*-statistics using White (1980) heteroscedastic standard errors are within parentheses.The *Nouveau Marché* dummy equals one if the firms goes public on this market and zero otherwise. The technology dummy equals one if the firm is active in the technology sector as defined by Loughran and Ritter (2004).Pre-valuation market return and the pre-valuation market volatility relate to the market index buy-and-hold return and standard of deviation of daily market index returns in the period of 100 trading days before the underwriter report was released. We used the MSCI France index to compute marketreturns.See Table 2 for other variable definitions. [a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on the particular valuation technique(s) that the underwriter uses.

**Table 10**
Pricing IPOs

| Column | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable | Deliberate price discount | Price update | Underpricing | Underpricing, 10 days | Underpricing |
| Log(Total assets) | -0.006 | 0.007 | -0.011 | -0.034 | 0.001 |
| | (-0.975) | (1.240) | (-0.716) | (-1.313) | (0.067) |
| Log(1+company age) | -0.005 | 0.007 | -0.026 | -0.051 | -0.030 |
| | (-0.571) | (1.322) | (-1.805)[c] | (-2.188)[b] | (-1.769)[c] |
| Profitability | -0.147 | 0.023 | 0.118 | -0.030 | -0.126 |
| | (-1.823)[c] | (0.455) | (0.758) | (-0.071) | (-0.677) |
| Sales growth | -0.006 | 0.026 | 0.012 | -0.050 | -0.154 |
| | (-0.331) | (1.747)[c] | (0.321) | (-0.778) | (-1.518) |
| Underwriter reputation | -0.210 | -0.081 | 0.391 | 0.299 | 0.155 |
| | (-2.035)[b] | (-0.788) | (1.041) | (0.517) | (0.392) |
| Dilution factor | -0.052 | -0.054 | -0.187 | -0.253 | 0.013 |
| | (-0.963) | (-1.523) | (-1.570) | (-1.383) | (0.141) |
| Participation ratio | 0.018 | -0.037 | -0.077 | -0.195 | -0.159 |
| | (0.296) | (-0.803) | (-0.557) | (-0.734) | (-1.183) |
| *Nouveau Marché*dummy | 0.023 | 0.019 | -0.027 | -0.079 | -0.041 |
| | (1.194) | (1.274) | (-0.707) | (-1.069) | (-0.723) |
| Technology dummy | 0.023 | 0.024 | 0.082 | 0.080 | 0.048 |
| | (1.278) | (1.664)[c] | (2.164)[b] | (1.232) | (1.879)[c] |
| Average absolute prediction error | 0.153 (2.237)[b] | | | | |
| Pre-valuation market return | -0.011 (-0.262) | | | | |
| Pre-valuation market volatility | 1.914 (0.782) | | | | |
| Pre-pricing market return | | 0.082 (3.023)[a] | | | |
| Pre-pricing market volatility | | -1.966 (-2.012)[b] | | | |
| Auction dummy | | 0.067 | -0.095 | -0.175 | -0.153 |
| | | (6.186)[a] | (-3.190)[a] | (-3.402)[a] | (-4.059)[a] |
| Deliberate price discount | | 0.193 | 0.265 | 0.225 | 0.298 |
| | | (4.096)[a] | (2.134)[b] | (2.010)[b] | (2.345)[b] |
| Price update | | | 0.363 | 0.522 | 0.714 |
| | | | (2.025)[b] | (2.034)[b] | (2.225)[b] |
| Post-pricing market return | | | 1.296 | 1.131 | 1.240 |
| | | | (2.267)[b] | (2.492)[b] | (2.094)[b] |
| Post-pricing market volatility | | | 0.934 | 0.711 | 0.618 |
| | | | (0.426) | (0.971) | (0.178) |
| Oversubscription rate | | | | | 0.001 |
| | | | | | (2.403)[b] |
| Intercept | 0.190 | -0.050 | 0.238 | 0.509 | 0.219 |
| | (4.195)[a] | (-1.351) | (2.166)[b] | (2.399)[b] | (1.571) |
| Adjusted $R^2$ | 0.116 | 0.283 | 0.171 | 0.162 | 0.295 |

| | | | | | |
|---|---|---|---|---|---|
| F-statistic | 3.432[a] | 7.881[a] | 4.345[a] | 3.534[a] | 4.260[a] |
| N | 228 | 228 | 228 | 228 | 118 |

Note: Table shows cross-sectional OLS regression results using IPO pricing variables as dependent variables. *t*-statistics using White (1980) heteroscedastic standard errors are within parentheses. The *Nouveau Marché* dummy equals one if the firms goes public on this market and zero otherwise. The technology dummy equals one if the firm is active in the technology sector as defined by Loughran and Ritter (2004).The average absolute prediction error is calculated as the average absolute prediction error (accuracy) of fair value estimates in the 100 trading days before the publishing date of the underwriter report. Pre-valuation market return and the pre-valuation market volatility relate to the market index buy-and-hold return and standard of deviation of daily market index returns in the period of 100 trading days before the underwriter report was released. Pre-pricing market return and the pre-pricing market volatility relate to the market index buy-and-hold return and standard of deviation of daily market index returns between the date the underwriter report was published and the date the final offer price was set. The auction dummy equals one in case the IPO was sold via an auction. Post-pricing market return and the post-pricing market volatility relate to the buy-and-hold market index returnand standard of deviation of daily market index returns during the interval between the setting of the final offer price and establishing the equilibrium market price. We used the MSCI France index to compute market returns.Underpricing, 10 days is calculated as (market value 10 days after the equilibrium market value has been established– final offer value)/final offer value. Oversubscription rate is the number of times the IPO was oversubscribed measured as total shares demanded/shares offered in the IPO. See Table 2 for other variable definitions. [a] significant at the 1% level; [b] significant at the 5% level; [c] significant at the 10% level. Sample sizes (N) vary depending on data availability.

**Highlights**
**"Valuing and pricing IPOs"**
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- We investigate how underwriters set the IPO firm's fair value
- Multiples, dividend discount and discounted cash flow models are used
- Underwriters apply a discount to fair value to set the preliminary offer price
- This discount can be partially recovered by higher price update but not in full
- The discount therefore contributes to IPO underpricing