

# Accounting for Software Development Costs and the Cost of Capital: Evidence from IPO Underpricing in the Software Industry

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# Accounting for Software Development Costs and the Cost of Capital: Evidence from IPO Underpricing in the Software Industry

## **Abstract**

The paper assesses the value of the information contained in management's determination of the accounting treatment for software development costs. The assessment is made in the context of the initial public offerings (IPO) market and is based on the effect of the accounting treatment on information asymmetry and hence IPO underpricing. We hypothesize that by sharing information about the probability of recoverability of software development costs and the amortization period, management that elects capitalization reduces information asymmetry and thus underpricing. The results, based on a sample of 390 IPOs in the software industry, are consistent with the hypothesis. The findings suggest that the option to capitalize, through its information impact, lowers the cost of capital. Alternative interpretations of the findings are discussed as well.

JEL classification: G10; M41

KEY WORDS: Accounting for software development costs (SDC), IPO underpricing, information asymmetry, cost of capital

## **Accounting for Software Development Costs and the Cost of Capital: Evidence from IPO Underpricing in the Software Industry**

### **1. Introduction**

A considerable body of research in accounting examines the information content of disclosures relating to intangible assets. The common finding of this research is that investors consider the investment in intangibles an asset, whether the investment is capitalized (e.g. goodwill, some software development costs and oil exploration costs) or expensed (e.g., R&D, information technology, human resources, some software development costs and oil exploration costs).

The finding that investments in intangibles are valued by investors is often used as an argument in support of capitalizing these expenditures. Note, however, that by virtue of being undertaken by firms, investments in intangibles must have a positive expected net present value, at least in the eyes of the investing firms' management and most likely in the eyes of investors as well. In this respect, the empirical finding that the market views R&D expenditures as an asset merely confirms the obvious - that investors do not question the wisdom of investing in intangibles. Nor do accountants raise this question, even though generally accepted accounting principles (GAAP) mandate the expensing of R&D expenditures. In fact, the reason for this expensing requirement by GAAP does not arise because the level of R&D's expected net benefits, but rather because of the uncertainty surrounding them.<sup>1</sup> Expensing the cost of these intangibles is in line with the accounting definition of an asset. Namely, for an investment to qualify as an asset on the balance sheet it should not only be associated with expected net economic benefits but these benefits must also be "probable."<sup>2</sup> While the condition of having "probable economic benefits" is not precisely defined, it suggests that a relatively high degree of certainty about the investment's recoverability is needed before it qualifies as an accounting asset.

The perennial debate on whether to capitalize or expense the cost of intangibles thus cannot be resolved in favor of capitalization by the finding that the market positively values intangible investment. However, empirical support for capitalization can be provided by two other types of

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<sup>1</sup> Other important considerations in the FASB's determination not to allow capitalization of some intangible assets are the reliability, integrity and comparability of the financial statements.

<sup>2</sup> See par. 25, FASB Statement of Concepts 6 (1985).

evidence. One type of such evidence is that showing that the uncertainty regarding future benefits of intangibles is not “sufficiently” higher than that of tangible assets (such as PPE) that are capitalized so as to warrant a different accounting treatment. Surprisingly, the evidence on the differential degree of riskiness of intangible, as compared with tangible assets, is scant. To our best knowledge the only paper that addresses this issue is Kothari, Laguree and Leone (2002), which provides important evidence on the comparative uncertainty of expenditures on R&D and PPE.

Another support for capitalization could be in the form of evidence showing that capitalization, when allowed, is informative to investors. In the U.S., the only costs of internally-developed intangibles that are allowed to be capitalized (under certain conditions) are those associated with software development (see SFAS 86).<sup>3</sup> Interestingly, managerial discretion with respect to the accounting treatment of software development costs (hereafter, SDC) has recently come under attack from the same software industry groups that staunchly supported the introduction of SFAS 86. For example, the Software Publishers Association – the trade group of software producers – that lobbied very hard for allowing companies to capitalize their SDC, has recently filed a petition with the Financial Accounting Standards Board (FASB) seeking abolition of the SFAS 86 and asserting that the FASB should mandate the expensing of SDC.<sup>4</sup>

We contribute to the debate by examining whether capitalization of SDC is more informative than the expensing alternative, consequently lowering the cost of issuing new equity. Our analysis is made in the context of the initial public offerings (IPO) market. We hypothesize that, by capitalizing the portion of its SDC that occurred after the technological feasibility stage, management reveals to investors its beliefs with respect to the distribution of future benefits. Specifically, capitalization indicates that it is probable that the (capitalized) SDC be recovered,

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<sup>3</sup> SFAS 86 requires that costs involved in software creation be treated according to the technological feasibility of the project. Technological feasibility is typically established upon completion of a detailed program design or working model. All costs prior to achieving the technological feasibility stage must be expensed as incurred as R&D. Software development costs incurred subsequent to achieving technological feasibility, labeled “software production costs” by SFAS 86, must be capitalized. The assessment of product eligibility for capitalization is made on a product-by-product basis. In practice, the assessment of technological feasibility is influenced by managerial discretion.

<sup>4</sup> Aboody and Lev (1998) suggest reasons for software companies’ change of heart towards the capitalization of SDC. First, capitalization generally results in higher *reported* earnings. However, by the mid-1990s firms in the software industry had matured to the point where the income-increasing capitalization of SDC began to be offset by the income-decreasing amortization of capitalized SDC. Consequently, the decision to capitalize or expense made little difference in reported earnings for large and mature software companies. Secondly, analysts have consistently objected to SFAS 86, as capitalization adversely affected their earnings forecast ability.

i.e., that management's probability distribution of future cash flows is truncated from below. In contrast, management's election to expense all its SDC provides no information on the distribution of future cash flows arising from the investment in software development. Therefore, SDC capitalization, by being more informative about the distribution of future cash flows, reduces information asymmetry and thus lessens the extent of IPO underpricing<sup>5</sup> of firms that capitalize these costs ("capitalizers") relative to firms that expense them ("expensers").

Our choice of the IPO setting is motivated by the following considerations. First, the effects of information asymmetry with respect to the outcome of investments in intangibles such as SDC are likely to be even more pronounced for IPOs than for seasoned stocks. IPO firms generally have no track record, limited historical data and no established analysts' coverage. This makes the IPO setting uniquely suited for testing the role of accounting disclosures when the availability of competing sources of information is limited. Second, IPO underpricing is a well-documented phenomenon whose most established explanation is information asymmetry (Welch and Ritter (2002)). The theoretically established relation between the degree of IPO underpricing and the extent of information asymmetry enables us to use underpricing, which is observable, as a proxy for the unobservable information asymmetry. Finally, IPO underpricing reflects the amount of money initial owners leave on the table for new shareholders, and constitutes an *actual* cost of new equity financing. By relating IPO underpricing to accounting disclosures, we are able to assess the effect of these disclosures on the cost of issuing new equity. Given that the cost of capital plays a vital role in resource allocation within an economy, this study provides *direct* evidence on the economic consequences of the accounting treatment of SDC.

The results of the paper are consistent with the notion that capitalization reduces information uncertainty of investors in IPOs. After controlling for its other determinants and sample-selection bias, IPO underpricing is significantly and materially smaller for firms that capitalize SDC than for firms that expense SDC. The reduction in underpricing due to SDC capitalization is not only statistically significant but also economically meaningful. Furthermore, we show that the extent to which the capitalization treatment reduces information asymmetry and hence IPO underpricing is a function of the intensity of SDC (ratio of the amount of annual SDC to the market value equity). The larger the SDC intensity, the greater the degree of information

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<sup>5</sup> IPO underpricing is measured as the appreciation of the stock from the offer price to the closing price at the end of the first trading day.

asymmetry and the greater is the reduction in underpricing due to the SDC capitalization. Finally, we find that for capitalizers, the IPO underpricing declines as capitalization intensity (the proportion of capitalized SDC out of total SDC) increases. This suggests that capitalization intensity is informative in differentiating the varying degrees of recoverability of SDC among the capitalizers.

Our findings have potential standard setting implications. One of the primary objectives of financial reporting is to foster a level playing field between informed and uninformed investors through accounting disclosures.<sup>6</sup> Our results suggest that allowing capitalization under appropriate circumstances rather than restricting the accounting treatment to expensing allows management to reveal its beliefs concerning the recoverability of the SDC. As a result, this accounting choice is likely to reduce the information asymmetry between investment professionals and average individual investors who are generally much more constrained with time, skills, and resources. consequently lowering the cost of capital.

While pertaining to the accounting for SDC, our findings also contribute to the on-going debate over the accounting treatment of other types of investments in intangibles whose expensing is mandated, most notably R&D.<sup>7</sup> The results of this paper provide an economic rationale for the argument that allowing firms to capitalize R&D costs under certain conditions, while resulting in subjective and imperfect measurements, may be preferable to the mandated expensing alternative.<sup>8</sup>

The remainder of the paper is organized as follows. The next section reviews the literature on the valuation of investment in SDC. Section 3 describes the phenomenon of IPO underpricing, the explanations provided for it and their relation to the investment in intangibles. Section 4 describes the hypotheses and the testing methodology. Data and sample selection are

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<sup>6</sup> SFAC No. 1 (par. 28) states that the objectives of financial reporting “stem primarily from the informational needs of external users who lack the authority to prescribe the financial information they want from an enterprise and therefore must use the information that management communicates to them”.

<sup>7</sup> The rule requiring R&D expensing faces a growing criticism. A consensus appears to have emerged that changes to the current R&D accounting are needed. For example, in the 2000 Financial Accounting Standards Advisory Council (FASAC) survey of the FASB’s projects and priorities, projects on intangible assets and accounting for R&D were ranked as the second and third highest priorities, respectively, by FASAC members, just behind business combinations. The Board has called for more research on accounting for intangibles.

<sup>8</sup> International Accounting Standard 38 and the vast majority of countries around the world (except the U.S., Germany and Mexico) allow the capitalization of some portion of R&D expenditures if certain conditions, primarily the technological feasibility criterion, are satisfied.

detailed in section 5. The results, their analysis, robustness checks and alternative explanations for the results are provided in section 6. The last section of the paper contains concluding remarks.

## **2. Related Prior Studies**

A large body of research exists on the valuation of investment in intangibles. Among the studies on the valuation of expenditures on intangibles are those that examine R&D costs (Chan, Martin and Kessinger (1990), Den Adel (2001), Lev and Sougiannis (1996), Lev and Zarowin (1999), Shi (2003) and Sougiannis (1994)); investment in brand names and trademarks (Barth, Clement, Foster and Kasznik (1998) and Seethamaraju (2000)); advertising expenditures (Bublitz and Ettredge (1989)); goodwill (Chauvin and Hirschey (1994)); patents (Hall, Jaffe and Trajtenberg (2005)) and human resources (Hanson (1997)). Most of these studies provide evidence consistent with the notion that investment in intangibles enhances, rather than detracts from, the value of the firm.

Aboody and Lev (1998) show that stock returns are associated differently with capitalized vs. expensed software development costs. The value relevance of SDC suggests that the capitalized SDC reflect information consistent with that used by investors in firm valuation. While this finding is important, it sheds no light on whether the information conveyed by the firm's choice of its accounting treatment of SDC in accordance with SFAS 86 provides "news" to investors and reduces the information asymmetry between insiders or investors privy to inside information and uninformed investors.

Mohd (2005) shows that the introduction of SFAS 86 reduced information asymmetry (as measured by the bid-ask spread and trading volume) relating to software companies in the secondary market. Our paper differs from his in at least two ways. First, a vast IPO literature in finance shows that the IPO market has unique institutional features that lead to information environments and pricing phenomena (e.g., initial underpricing and subsequent poor long-term performance) that are absent in the secondary market<sup>9</sup> (for a review of the IPO literature, see

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<sup>9</sup> For example, unlike in the secondary market where all investors can participate in the trading of shares, the allocation of IPOs is generally determined by underwriters. Ritter and Welch (2002) argue that the average first-day IPO underpricing of nearly 19% from 1980 to 2001 cannot be explained by fundamental risks or liquidity constraints in the secondary market. They conclude (p. 1803) that "the solution to the underpricing puzzle has to lie in focusing on the setting of the offer price, where the normal interplay of supply and demand is suppressed by the underwriter."

Ritter and Welch (2002)). Hence, the results from Mohd (2005) cannot be generalized into the IPO setting. Second, Mohd (2005) does not examine the impact of SDC capitalization on the cost of capital. A recent theoretical paper by Lambert, Leuz and Verrecchia (2006) demonstrates that the disclosure effects are more complicated than previously understood and that the link between information quality and the cost of capital is ambiguous in the secondary market. Our study is the first that provides direct evidence on the informational effect of SDC capitalization on the cost of issuing new equity.

### **3. The IPO Underpricing Phenomenon and the Accounting Treatment of SDC**

In an IPO, a firm goes public by issuing securities to the public. The typical process of an IPO involves two steps. In the first step, the securities are offered to investors at some predetermined price (hereafter, “the offer price”). Based on the quantity subscribed, allocation of the issued securities among the subscribing investors is made. Subsequently, the securities begin to trade publicly on the stock exchange, with an opening price that is determined by market demand and supply.

An intriguing phenomenon in financial markets is the underpricing of IPO, as evidenced by significant positive abnormal return on the first day of trading in the new securities. Ostensibly, this phenomenon is inconsistent with efficient markets and with effective information processing by issuers, underwriters and investors. Different theoretical explanations for the underpricing of IPOs have been suggested, the best known and most studied of which is arguably adverse selection, first modeled by Rock (1986).

Rock develops a model showing that IPO underpricing is a consequence of rational behavior by issuing firms in an environment characterized by information asymmetry between different investors. Specifically, there are “informed investors” who have superior (or even perfect) information about the true value of the issue and “uninformed investors” who know only the probability distribution from which this value is drawn. As a result of this information asymmetry, uninformed investors have a greater probability of ending up buying undesirable offerings. In order to induce uninformed investors to participate in the IPO market, issuers must thus under-price the securities to compensate the uninformed. Once trading in the security begins, informed investors, through their trades reveal their information and the asymmetry of information between informed and uninformed investors dissipates. The relevant prediction of

Rock's model for our study is that *IPO underpricing is a monotonic function of the degree of information asymmetry*. Rock's model has been validated by a number of empirical studies (e.g., Beatty and Ritter (1986) and Koh and Walter (1989)).<sup>10</sup> In particular, Rock's prediction that information asymmetry affects IPO underpricing has been tested by a number of recent studies that use the extent of voluntary disclosure as a proxy for information asymmetry. Schrand and Verrecchia (2004) show that the frequency of meaningful public announcements is negatively related to IPO underpricing. Leone, Rock and Willenborg (2006) provide evidence that increased specificity of an IPO firm about the intended uses of the IPO proceeds is negatively correlated with IPO underpricing. Similar results on the association between voluntary disclosure and IPO underpricing are obtained for the Canadian market by Jog and McConomy (2003).

Certain characteristics of investments in intangible costs make them likely to generate asymmetry of information among investors. These characteristics include the uncertainty about the investment outcome, the specialized knowledge often required to assess their potential success and the lack of timely external indications for their progress. The notion that investment in intangibles creates information asymmetry has been used by several studies to identify the effect of this asymmetry on management, investor and analyst behavior. For example, Barth and Kasznik (1999) show that information asymmetry induced by the presence of intangibles is positively associated with stock returns during periods of repurchase announcements. Barth, Kasznik and McNichols (2001) find that after controlling for other firm attributes, firms with significant intangible assets attract more analyst coverage. This finding is consistent with the notion that there is a greater information asymmetry between firm's insiders and investors for firms with more intangible assets. Ali, Durtchi, Lev and Trombley (2000) show that, based on abnormal return around changes in institutional holdings, information asymmetry between institutional investors and other investors is more pronounced for firms with measures of unrecorded intangible assets. Finally, Aboody and Lev (2000) demonstrate that information on R&D is a major contributor to information asymmetry and insider gains.

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<sup>10</sup> Other information-based models were developed in the literature in an attempt to explain the underpricing phenomenon (e.g., the principal-agent model by Baron (1982) and signaling models by Grinblatt and Hwang (1989) and Welch (1989). While these models assume different informational environments for investors, underwriters and issuers, they all suggest a positive relation between the degree of information asymmetry (or uncertainty) regarding share value and the extent of underpricing.

Whether the “informed” parties are management, other insiders, underwriters or sophisticated investors, the degree of information asymmetry between informed and uninformed investors is reduced by the firm’s mandated or voluntary disclosures. In particular, capitalizers typically report on their financial statements the following items pertaining to software development activities: net cumulative capitalized SDC on the balance sheet (a long-term asset), total amounts of annual SDC capitalized and expensed, and annual amortization expense of the cumulative capitalized SDC. Therefore, management’s decision to capitalize SDC reveals, in the absence of opportunistic reporting, management beliefs about the distribution of future benefits arising from the investment in software development. This is so because capitalization of SDC is allowed only when certain milestones of the software development project is reached, e.g., the establishment of the software’s technological feasibility. Capitalization of SDC, aside from conveying “good news” by revealing management’s assessment that the likelihood of cost recoverability is high (or that the recovery is “probable,” consistent with the accounting definition of an asset), provides more information on the probability distribution of future benefits than expensing. Moreover, the amortization schedule disclosed along with the capitalization decision is informative about the duration of future benefits.

Expensers, however, disclose only total annual SDC, all of which is expensed as incurred in the reporting year. Expensing, hence, is less revealing because it does not indicate a restriction on the distribution of future benefits. In fact, by expensing, management (an informed party) shares only information on the total amount of annual SDC with uninformed investors so that investors’ posterior distribution given this accounting treatment is as dispersed as their a-priori distribution.<sup>11</sup> In contrast, the truncation of the distribution of future payoffs from below, indicated by capitalization, meaningfully reduces the dispersion of the distribution of future payoffs.<sup>12</sup> Furthermore, expensing does not convey any information that management possesses regarding the duration and pattern of future benefits.

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<sup>11</sup> The expensing decision could be potentially informative to investors in the sense that it may indicate management’s assessment that the firm’s software projects under development are likely to fail. However, expensing of SDC may also be a result of the firm’s accounting choice even though it has successful products and is eligible for the capitalization treatment (as is the case with Microsoft and Novell). Because outside investors cannot disentangle these scenarios, the expensing signal has little information.

<sup>12</sup> This is particularly true if this distribution (both prior and posterior) is also truncated from above. The upper truncation is likely because the benefits are typically capped by the size of the market, the prospect of technological changes and competitive pressures.

This discussion suggests that if IPO underpricing is positively associated with the extent of information asymmetry, the underpricing will be more pronounced for IPO firms that expense their SDC. This is the main hypothesis tested in this paper through the methodology described in the following section.

Note that the underlying assumption of our investigation is that capitalizers on average make the capitalization determination in adherence with SFAS 86. In particular, a capitalization decision suggests that, in management's opinion, the recoverability of the costs of software development is probable. This assumption is supported by evidence provided by Aboody and Lev (1998) who show that capitalized SDC is valued more by investors and, indeed, associated with greater future profitability than expensed SDC. Further, should this assumption do not hold in our sample,<sup>13</sup> capitalization of SDC would not be informative and it would create a bias against our finding of more informative reporting by capitalizers.

#### **4. Hypotheses and Methodology**

In order to test whether the accounting treatment of SDC has the potential to reduce information asymmetry, we relate the degree of IPO underpricing to whether the issuing firm capitalizes or expenses these costs. Specifically, our main hypothesis is (all hypotheses are stated in their alternative form):

**H1: After controlling for other factors affecting IPO underpricing, the extent of underpricing is smaller for capitalizers as compared with expensers**

In a similar vein, we hypothesize that the degree of IPO underpricing among capitalizers (i.e., firms that capitalize at least part of the SDC) is negatively related to the extent of SDC capitalization. The greater the proportion capitalized, the lower is the uncertainty and dispersion of the net future benefits and hence the lower the underpricing, leading to the following hypothesis:

**H1A: After controlling for other factors affecting IPO underpricing, the extent of underpricing for capitalizers is negatively related to the SDC capitalization intensity.**

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<sup>13</sup> We verify the essence of Aboody and Lev's findings by examining the differential valuations of capitalized versus expensed SDC in our IPO sample, and reach similar conclusions.

H1 is tested using the following cross-sectional regression (time and firm subscripts omitted):

$$\text{UNDER} = \delta_0 + \delta_1 \text{DCAP} + \sum \delta_i \text{Control}_i + \varepsilon \quad (1)$$

where UNDER is the extent of underpricing, measured as the percentage appreciation from offer price to the closing price of the first trading day adjusted for the contemporaneous market index return, and DCAP is a dummy variable that receives the value 1(0) if the firm capitalizes (expenses) its SDC. The control variables are discussed in the following section. If H1 holds, then  $\delta_1$  should be negative. The coefficient  $\delta_1$  reflects the effect of asymmetry of information conveyed by the firm's capitalization decision on IPO underpricing.

H1A is tested by estimating regression (1) from a sample of capitalizers, replacing DCAP with the proportion of capitalized SDC (CAP-RATE). Specifically, we run the following regression for the subsample of firms that capitalize SDC:

$$\text{UNDER} = \delta_0 + \delta_1 \text{CAP-RATE} + \sum \delta_i \text{Control}_i + \varepsilon \quad (2)$$

where CAP-RATE is the SDC capitalization intensity, measured as the ratio of capitalized SDC to the firm's market value based on the offer price.<sup>14</sup> The other variables are defined as in regression (1). A significantly negative coefficient of CAP-RATE would be consistent with H1A.

To the extent that software development is a major source of information asymmetry, everything else being equal, the impact of capitalization on alleviating information asymmetry (and thus reducing IPO underpricing) is expected to be greater for firms of high SDC intensity than for firms of low SDC intensity. This leads to a following hypothesis:

**H2: After controlling for other factors affecting IPO underpricing, the difference in the extent of underpricing between expensers and capitalizers is positively related to the firm's SDC intensity.**

Hypothesis H2 is tested by augmenting regression (1) with a variable that represents SDC intensity. Specifically, we test H2 by estimating the following regression:

$$\text{UNDER} = \delta_0 + \delta_1 \text{DCAP} + \delta_2 \text{DCAP} * \text{DINTENS} + \delta_3 \text{DINTENS} + \sum \delta_i \text{Control}_i + \varepsilon \quad (3)$$

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<sup>14</sup> Our results do not change when CAP-RATE is measured as the ratio of capitalized SDC to either total annual SDC, annual sale revenues or market value based on the first trading day closing price.

UNDER, DCAP and the control variables are defined as in regression (1) and DINTENS is a dummy variable that receives the value of 1 (0) if the software development intensity (the ratio of SDC to the firm's equity value) is below (above) the top quartile of the distribution of this variable. We use a dummy variable in place of a continuous measure of SDC intensity since the effect of software development on information asymmetry may not be linear.<sup>15</sup>

In regression (3), both  $\delta_1$  and  $\delta_2$  reflect the effect of asymmetry of information conveyed by the firm's capitalization decision on IPO underpricing. Given the presence of the interactive dummy variable, DCAP\*DINTENS,  $\delta_1$ , the coefficient of DCAP in regression (1), indicates the extent of the differential underpricing for SDC-intensive firms (DINTENS = 0) that capitalize these costs relative to high-intensity SDC-firms that expense them. If H1 holds even for low-intensity SDC firms, we expect  $\delta_1 + \delta_2$  (the extent of differential underpricing between low intensive SDC-capitalizers and low intensive SDC-expensers) to be negative. If H1 holds for at least the SDC-intensive firms, we expect  $\delta_1$  to be negative. If H2 holds, we expect  $\delta_2$  to be positive.

#### **4.1. Control variables**

To assess the marginal differential impact of capitalizing vs. expensing software development costs on IPO underpricing, we include a number of additional independent variables that are suggested by the IPO literature as affecting the extent of IPO underpricing. They relate to the degree of uncertainty, the extent of asymmetry of information, or both, as described below.

##### **4.1.1. Control variables suggested by the IPO literature**

The first control variable is the *size of the issue*. On one hand, larger firms are presumably less risky than smaller firms. Some previous studies ([e.g., Beatty and Ritter (1986)]) show that the size of the issue (as measured by its proceeds) is negatively related to the extent of underpricing. On the other hand, larger issues may entail greater underwriting and distribution efforts, leading to greater underpricing, as suggested by Baron (1982) and Michaely and Shaw (1994). Given the conflicting arguments and evidence, we do not offer a definitive prediction of the sign of the coefficient on size. Consistent with the extant IPO literature, we measure the size of the issue as the natural logarithm of the issue proceeds and denote it as PROC.

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<sup>15</sup> We obtain qualitatively similar results when we use alternative partitions of the software development intensity or when we replace DINTENS with a continuous measure of the software intensity.

The second control variable is the *underwriter's reputation*. Prior studies document that the degree of underpricing is negatively related to underwriter prestige (e.g., Carter and Manaster (1990); Carter, Dark and Singh (1998)). We use a discrete underwriter reputation variable 0-9 constructed in Carter and Manaster, where a "9" represents the most prestigious underwriter and "0" indicates the least prestigious underwriter. We denote this variable as REPUT.

The third control variable is the percentage of the *ownership retained by insiders*. Models of IPO underpricing show that that the percent ownership retained by insiders signals private information about firm value by the insiders to investors and that the extent of the IPO underpricing is positively related to the ownership retained by insiders (e.g., Leland and Pyle (1977), Grinblatt and Hwang (1989) and Welch (1989)). This variable is denoted INSIDE and calculated as the percentage of ownership retained by the insiders.

The fourth control variable is the uncertainty about firm value at the time of the issue as proxied by the firm's *return variability*. Prior studies have used aftermarket volatility as a proxy for ex ante uncertainty (see Barry, Muscarella and Vetsuypens (1991) and Carter, Dark and Singh (1998)). The return variability, computed as the standard deviation of the 200 daily raw returns commencing five days after the IPO, is employed to proxy for the uncertainty about firm value. This variable is denoted STD and is expected to be positively associated with IPO underpricing.

The fifth control variable is the *quality of the auditor*. The inclusion of this variable is motivated by the findings of Beatty (1989) and Hogan (1997) that auditor quality, as gauged by the size of the auditing firm, is an important determinant of IPO underpricing. AUDITOR is a dummy variable that receives the value of 1 if the auditor is one of the Big-Eight firms and 0 otherwise. Reputable auditors can serve the role of certification in IPO performance. To the extent that certification removes investor uncertainty about share value, auditor reputation is expected to be inversely related to IPO underpricing.

The *firm's age* may also affect underpricing since age proxies for the availability of information on the company and its software development projects. We therefore expect that the degree of information asymmetry is lower for older firms and hence their IPOs are less underpriced (see Carter, Dark and Singh (1998) and Leone, Rock and Willenborg (2003)). We measure age as the number of years from date of incorporation to IPO issuance date.

Meggison and Weiss (1991) document that the *presence of venture capitalists* in the issuing firms serves to lower the costs of going public. We capture the venture capital's backing, VC, using a dummy variable taking the value of 1 if an issue is backed by venture capitalists and 0 otherwise.

Another variable identified by past research to be related to IPO underpricing is **revisions in the offer price**. Prior IPO underpricing studies hypothesize and find that revisions in the offer price during the IPO process reflect uncertainty about the true value of the IPO shares, hence are positively correlated with the degree of IPO underpricing (e.g., Benveniste and Spindt (1989)). Following Leone, Rock and Willenborg (2003), we set the variable PREVISION (price revision) equal to zero, one or two if the final offer price is below, within, or above the initial offer price range in the IPO prospectus. We expect PREVISION to be positively correlated with IPO underpricing.

Finally, following Tinic (1988) and Leone, Rock and Willenborg (2003), we include the *inverse of the offer price* as a determinant of IPO underpricing. To the extent that low-priced IPOs tend to be issued by highly speculative firms, the inverse of the offer price is hypothesized to be positively associated with the degree of underpricing (Tinic (1988)). On the other hand, given issue size lower offer price means a larger number of shares being offered and traded which would improve trading liquidity and potentially lower stock returns (Butler, Grullon and Weston (2005)). We, hence, do not have a prediction of coefficient sign for the variable.

#### **4.1.2. Sample-selection bias**

The decision to capitalize or expense software development costs is endogenously determined by the firm's software development activities (e.g., whether or not a project under development has reached the technological feasibility stage). To a limited extent the accounting choice is also affected by management reporting objectives (e.g., maximizing current period's reported income, portraying a conservative reporting stance, income smoothing, etc.) and the scrutiny of third parties such as auditor and underwriter who must conduct due diligence investigations during the IPO process. The accounting treatment, expensing versus capitalization, thus may be correlated with, or even induced by, characteristics of the IPO firm that relate to IPO underpricing. Controlling for these variables is necessary in order to ascertain that any observed relation between the accounting treatment of SDC and IPO underpricing is not due to the

differences in the underlying economics of the capitalizers and expensers but rather to the differential information content of the accounting treatments.

To address the issue of sample-selection bias, we apply the approach used by Aboody and Lev (1998) whereby we include in the regression a control variable that represents the expected percentage of capitalized SDC to the market value of the firm's equity (*CAP-RATE*) given the firm's characteristics. In line with Aboody and Lev's prediction model, these characteristics are firm size,<sup>16</sup> the profitability to sales, software development intensity, and leverage. Relevant to our IPO sample, we include two additional firm attributes—the quality of the auditors and the age of the firm—as explanatory variables. Presumably, a more reputable auditor will likely be more resistant to management's attempts to capitalize SDC when it is not appropriate to do so (Trombley (1989)). Further, older firms are more likely to have software projects that have reached technological feasibility and thus qualify for capitalization. The estimated model is thus:

$$\begin{aligned} \text{CAP-RATE} = & \delta_0 + \delta_1 \text{PROC} + \delta_2 \text{PROFIT} + \delta_3 \text{INTENS} + \delta_4 \text{LEV} \\ & + \delta_5 \text{AGE} + \delta_6 \text{AUDITOR} + \varepsilon \end{aligned} \quad (4)$$

where *CAP-RATE* is SDC capitalization intensity, measured as the ratio of the annually capitalized SDC (zero for expensers) to the market value based on the offer price, multiplied by 100, *PROC* is the natural logarithm of the offer price multiplied by total number of shares offered (in millions), *PROFIT* is net income (excluding software capitalization and amortization effects) over sales, *INTENS* is software development intensity measured as the annual SDC (amount expensed plus amount capitalized) over firm value, *LEV* is long-term debt over total assets excluding capitalized software assets, *AGE* is the natural logarithm of one plus firm age, where firm age is measured as the number of years from date of incorporation to IPO issuance date, and *AUDITOR* is a binary dummy variable, equal to 1 if an issuer is audited by a Big-Eight accounting firm and 0 otherwise.

Consistent with Aboody and Lev (1998), we control for firm attributes related to the decision of capitalizing versus expensing by including the predicted values of *CAP-RATE* (*PRECAP-RATE*) from regression (4) as an explanatory variable in equations (1) and (3). As a

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<sup>16</sup> Consistent with the IPO literature, we use the IPO issue size to control for size effect. As expected, the issue size is highly correlated with commonly used firm size measures such as total assets and market value of equity.

robustness check, we also apply the treatment effects model to account for the endogenous nature of the alternative accounting methods (section 6.5.3). Our conclusions remain intact.

Note that the distribution of CAP-RATE is left-censored at zero. Hence, we estimate equation (4) using the Tobit model, which is theoretically superior to the OLS regression as the OLS regression of a censored variable yields inconsistent estimates.

## 5. Sample and Data

The initial sample consists of 551 domestic U.S. software IPOs with primary SIC codes 7371-7374 obtained from the Global New Issues database of Securities Data Company beginning with 1986, the year SFAS 86 became effective, to 1998. The year 1998 was selected as the last year in the sample because an increasingly significant portion of software IPOs after 1998 were Internet IPOs. We chose to exclude IPOs of Internet stocks because they are characterized by considerable over subscription and unusually large first day price hikes (i.e., underpricing). Further, the pricing of the Internet IPOs cannot be explained by information-based rational valuation models (e.g., Ritter and Welch (2002)). The database contains all of the IPO-related variables used in this study (e.g., offer price, the first trading day closing price, issue proceeds and lead underwriters). Consistent with prior IPO studies, unit offers are excluded from our initial sample.

To be included in the final sample, the observation (firm-year) has to have information on the accounting treatment of SDC and the current period's SDC. Firms that capitalize SDC expenditures have to further have the amount out of the periodic expenditures that is capitalized, the amortization or write off of SDC and the ending balance of the capitalized SDC. This information was hand-collected from the first public annual reports or the 10-Ks after the IPO.

The above data requirement eliminated 147 issues from the initial sample. The sample is further reduced by excluding six issues whose primary business lines are not software development or that are F-20 foreign companies and six issues with no price/return data from CRSP. Finally, an influence diagnostics analysis of the main regression (1), based on the DFFITS statistic (Belsley, Kuh, and Welsch, 1980), reveals two influential observations.<sup>17</sup> We

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<sup>17</sup> We use a size-adjusted cutoff,  $2 * \sqrt{p/n}$ , which accounts for the sample size  $n$  and the fact that DFFITS increases as the number of independent variables,  $p$ , does (see pp. 27-29 of Belsley et al., 1980).

exclude the two IPOs from the analysis. The final sample consists of 390 IPOs, out of which 189 issuers are capitalizers and 201 issuers are expensers.

## **6. Results**

### **6.1. Descriptive statistics**

The composition of the sample is detailed in table 1. As shown in Panel A of the table, there is no time-clustering in any of the nine years examined. However, since 1995 there has been a surge in the number of software IPOs. This surge is related to the booming of the high-tech sector at that time and to an insatiable demand for software IPOs created by the widespread optimism among the investors about the new computer-related technologies. There is an increase in the percentage of expensers over time, which reaches about 67% in the last years of the sample. As shown in Panel B of the table, out of the four industries represented in the sample, most of the IPOs are of firms in the Prepackages Software industry (SIC code 7372).

{Insert table 1 here.}

Panel A of table 2 shows the effect of SDC capitalization on net income and total assets. The results suggest that whether companies capitalize or expense their SDC has an important effect on their financial statements. On average a capitalizer capitalizes 21.50% of its total SDC in the year of IPO issuance. On average, the effect of this capitalization is to increase net income by 10.46%, book value of equity by 9.64% and total assets by 6.76%. Additional descriptive statistics of capitalization related variables for the sample of 189 capitalizers are provided in panel B of table 2.

{Insert table 2 here.}

Table 3 shows the mean and median of the variables for the sample firms broken down by capitalizers and expensers. Significant differences exist between the means of the two groups with respect to a number of variables – SDC intensity (relative to market value of equity), market value of equity, profitability, return on asset, age, insider ownership, return variability, and IPO price revision. Capitalizers tend to be smaller but older firms with a greater SDC intensity,

higher profitability ratios<sup>18</sup>, lower insiders' ownership and a lower return variability. A significantly lower post-IPO stock return volatility for the capitalizers is consistent with the argument that capitalization of SDC is informative and reduces the information asymmetry in the IPO market.<sup>19</sup> All of the other firm characteristics are comparable between the capitalizers and expensers. Subsequent multivariate analyses control for the effects of the differentiating firm attributes.

{Insert table 3 here.}

Table 4 presents the Pearson correlation coefficients between the variables used in subsequent analyses. There is a significant correlation between a number of IPO underpricing determinants (e.g., issue proceeds, PROC, return variability, STD, and AGE). This is not surprising as these variables proxy for the same underlying construct—information asymmetry in the IPO market. Some of the correlations in table 4 however are induced by construction (e.g., the positive correlation between CAP-RATE (SDC capitalization intensity) and DCAP (SDC capitalization dummy) or between CAP-RATE and INTENS (SDC intensity—annual SDC over market value) or are otherwise consistent with the findings of the IPO literature regarding underpricing (e.g., a strong and positive correlation between the issue size, as measured by the proceeds from the IPO, the quality of auditors, AUDITOR, and underwriters' reputation, REPUT.)

{Insert table 4 here.}

## **6.2. Initial underpricing, firm characteristics and the accounting treatment of SDC**

Panel A of table 5 provides univariate analyses of the differences in the IPO discount, as measured by the market-adjusted stock return on the first day of the trading, among different subgroups in the sample. The table shows that the extent of underpricing of our sample

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<sup>18</sup> We also compare the mean and median of PROFIT and ROA for capitalizers and expensers, respectively, in the fiscal year prior to the IPO. Capitalizers have significantly higher profitability ratios than expensers at the mean and median levels. The evidence is consistent with the argument that a greater portion of capitalizers' SDC turns into successful software products and thus they have a better operating performance than expensers for both the IPO year and the year before the IPO.

<sup>19</sup> Consistent with this argument, we find that the average daily stock return volatility for the capitalizers is significantly lower than that for the expensers for each of the three years after the IPO. This result holds whether we measure the volatility based on raw daily stock returns, returns adjusted for contemporaneous value weighted market index, or excess daily returns that are residuals estimated from the market model.

companies is quite substantial, with a mean (median) of about 24% (15%), similar to the extent reported by previous studies (Welch and Ritter (2002)). The table also reveals that the underpricing of capitalizers is much smaller than that of expensers. Specifically, the mean (median) of the underpricing is 18.28% (10.88%) and 28.77% (18.98%) for capitalizers and expensers, respectively. This difference is significant at the 1% level, based on tests of differences between the means and between the medians.

Next, we compare the mean underpricing of the capitalizers with that of the expensers while controlling for each of the firm characteristics likely to affect the IPO underpricing level. As shown in panel B of table 5, the greater mean underpricing of expensers versus capitalizers remains even when we hold constant each of these firm characteristics.

{Insert table 5 here.}

Underpricing is more pronounced for larger companies. This is true particularly for the overall sample and for, separately, expensers and capitalizers. Recall from table 3 that expensers are larger than capitalizers. Ostensibly, the greater underpricing for expensers could reflect the fact that they are larger. The multivariate tests are designed to control for these confounding effects.

### **6.3. Differentiating capitalizers from expensers**

To identify firm characteristics that are associated with the decision of capitalizing and expensing, we regress SDC capitalization intensity on a set of firm characteristics as specified in regression (4). Recall that the dependent variable in regression (4), capital intensity, cannot take on a value of less than zero, we restrict the estimate of this variable to be greater than or equal to zero by estimating the regression using a one-sided Tobit procedure.

{Insert table 6 here.}

The results are reported in table 6. Consistent with Aboody and Lev (1998), we find that smaller, higher SDC intensity and higher leveraged firms tend to capitalize more of their SDC. In contrast to their finding, we document that firm profitability is positively associated with SDC capitalization, consistent with the argument that capitalizers are on average better performers than expensers. The significantly positive coefficient on SDC intensity (INTENS) suggests that the higher the firm's SDC intensity, the more likely it is that its software projects qualify for

capitalization, The coefficient on AGE is positive and marginally significant at the 11% level, indicating that the older firm capitalizes more of its SDC. The coefficient on AUDITOR is positive and not significant. This suggests that the propensity of firms to capitalize is not related to the presumed quality of the auditor. The insignificance of AUDITOR (and its unexpected sign) could be explained by the possible endogenous nature of the auditor's selection. Specifically, certain types of IPO firms are more likely to select Big-Eight accounting firms than others. The insignificant results may also be due to the fact that only few firms (20 out of 390 IPOs) in the sample have a non-Big-Eight auditor.

Following Aboody and Lev (1998), we include in subsequent tests the predicted value of SDC capitalization intensity (PRECAP-RATE) from regression (4) to control for differentiating firm characteristics related to the accounting treatment of SDC.

#### **6.4. The effect on SDC accounting treatment on IPO underpricing**

The differential underpricing of IPO firms that capitalize SDC and firms that expense these costs is gauged by the coefficient  $\delta_1$  in regression (1). The results from estimating regression (1) are provided in table 7.

{Insert table 7 here.}

Several findings emerge from table 7. Consistent with H1, after controlling for other determinants of IPO underpricing, the underpricing is smaller for capitalizers than for expensers. The reduction in underpricing associated with the capitalization treatment, as conveyed by  $\delta_1$ , is  $-8.00\%$  and significant at the 1% level. This is an economically important reduction when considering that the (unconditional) magnitude of average IPOs underpricing in the entire sample is about 24% (see table 5). Given a median issue size by expensers of \$31.78 million (see table 3) a mean underpricing difference of 8% translates into lower issue proceeds of about \$2.54 million for the median expenser. The coefficient  $\delta_1$  also indicates that a whopping 76 percent of the average unconditional differential underpricing between the expensers and capitalizers, which is 10.49%, (28.77%-18.28%, see table 5) can be explained by the accounting treatment of SDC.<sup>20</sup>

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<sup>20</sup> Note that the percentage of expensers increased in the post-1991 period (see table 1). Our data also reveal an increase in the extent of underpricing in that period. This raises the possibility that the higher underpricing associated with the expensers may be attributable to the increase in the proportion of expensers and in the overall underpricing in the latter sample period. To rule out this possibility, we introduce three subperiod dummies corresponding to the years pre-1992, 1992-1995 and post-1995. The three related subsamples consist of 70, 151 and

Except for underwriter reputation, REPUT, all of the control variables have the expected signs and about half of them are statistically significant at the conventional levels. As hypothesized by previous research, the sign of the revision in the offer price (from the one appearing in the prospectus) is positive and significant.<sup>21</sup>

Note that the coefficient of the predicted capitalization rate,  $\delta_{11}$ , is negative, as expected, but is significant only at the 10% significance level. The marginal significance of this variable may be due to the fact that two of the firm characteristics that are hypothesized to be associated with the accounting treatment, firm's age and auditors' quality, are hypothesized to affect underpricing directly and thus included as separate independent variables in regression (1).

While our use of an exhaustive list of IPO control variables helps mitigate the concern of correlated omitted variables, such approach exacerbates the multicollinearity problem of the regressors, consequently rendering some of the individual coefficients insignificant.

The results from testing H1A are tabulated in table 8. Conditional on the capitalization decision, the underpricing is significantly and negatively correlated with the percentage of the annual amount of capitalized SDC of the total market value of equity (CAP-RATE). The finding is consistent with the argument that capitalization rate conveys to the market information concerning the expected success rate of software projects by firm management, consequently reducing investors' perceived uncertainty over firm value and the IPO underpricing. In other words, the capitalization rate can differentiate between the varying degrees of recoverability of SDC among the capitalizers. The effect of the capitalization rate on underpricing is quite substantial: Each incremental percentage point of capitalized SDC over the firm's market value of equity is associated with a decline of 1.96 percentage points in IPO underpricing.

{Insert table 8 here.}

The results from testing H2, which states basically that the underpricing is a function of the materiality of the SDC amount, are presented in table 9. Several findings emerge from the

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169 observations, respectively. We use the pre-1992 as a baseline period and allow the latter two dummy variables to interact with DCAP. The results (not tabulated) show that the coefficients of the slope interaction terms are insignificant, suggesting that our results are not driven by the fact that underpricing and the proportion of expensers move together over time. As an alternative check, we randomly deleted the excess number of capitalizers (expensers) in the three subperiods so that the proportion of capitalizers and expensers is equal in the different subperiods. Replicating our main analysis using the modified sample, we obtained qualitatively similar results.

<sup>21</sup> PREVISION is defined as a discrete variable (see legend to table 7). However, similar results are obtained when a continuous variable (percentage revision relative the prospectus offer price) is used.

table. First, consistent with H2, the extent of the differential underpricing between capitalizers and expensers is an increasing function of SDC intensity, as indicated by a positive and significant  $\delta_2$ . In other words, the informational effect of SDC capitalization is much more pronounced for firms of high SDC intensity (a measure of high information asymmetry) than for firms of low SDC intensity. Second, consistent with H1 and the results reported in table 7, after controlling for other determinants of IPO underpricing, the underpricing is lower for capitalizers than for expensers, regardless of the SDC intensity. This is indicated by the fact that  $\delta_1$  and the sum  $\delta_1 + \delta_2$  are both negative.

{Insert table 9 here.}

Similar to the results of regression (1), the control variables in regressions (2) and (3) that are significant at the conventional levels have the expected signs. For example, the regression coefficients of equation (2) in table 8 indicates that older issuers, issuers with greater offer price revision, and issuers with venture capitalist backing tend to have lower IPO underpricing.

Taken together, the results are consistent with the joint hypothesis that (1) management truthfully reveals its expectations through the accounting treatment regarding SDC and (2) the information conveyed by the capitalization of SDC is informative. This finding has potential implications for accounting rule-setting because it suggests, subject to the qualifications in section 1, that giving firms the option to capitalize software development cost when certain conditions are met results in treatments that convey useful information to the market, potentially reducing information asymmetry and hence the firms' cost of capital.

Note in conclusion of this section that the capitalization decision is not the only mode of revealing relevant information for the assessment of future cash flows. For example, footnote disclosure is another channel that could be used by the issuers to convey such information to the market. If expensers have a more extensive disclosure about their software development projects (possibly by design, as a substitute for capitalization), the hypothesized information advantage of capitalizers would become less clear. This, however, would bias against finding a greater IPO underpricing of expensers. At any rate, we examine the extent of additional disclosure by reviewing the SDC-related footnote disclosures in the IPO prospectuses and the first 10K filing after the IPO of a subsample of over 30 IPO firms. We could not discern any systematic difference in the length and detail of the notes between expensers and capitalizers.

## **6.5. Robustness Tests**

### **6.5.1. Non-linearity**

In controlling for factors that might be correlated with underpricing and capitalization of SDC, we assume linear relation of these controls with underpricing. While linearity has been assumed also by past research, as a robustness check we also estimate equation (1) using rank regression in which all variables are transformed into ranks. The coefficient on our main variable of interest, DCAP, for the rank regression (not tabulated) is negative and significant at the conventional levels. Note that in addition to addressing possible non-linearity, the rank regression also mitigates the effect of potential influential observations.

### **6.5.2. Skewed dependent variable**

The dependent variable, underpricing (UNDER) is skewed (as evidenced, for example, by the gap between the median and the mean of the variable in table 5). Although the resulting bias in the estimated standard deviation may not be serious due to the fairly large sample, we estimate regression (1) using the natural log of underpricing ( $\log(100+\text{UNDER})$ ). The results (not reported) are similar to those obtained from the original estimation of that regression. In particular, DCAP is negative and significant at the 1% level.

### **6.5.3. Endogeneity**

In addition to adopting Aboody and Lev's approach dealing with sample selection bias (the approach is also used by Mohd (2005)), we also apply the treatment effects model to incorporate the endogenous nature of accounting choice of SDC. Specifically, our primary regression model of interest is equation (1) which estimates the effect of a binary treatment, DCAP (the accounting treatment dummy), on underpricing. The binary dummy variable is further modeled endogenously as a function of six firm characteristics as specified on the right-hand side of regression (4). We then run the treatment effects model using a two-step consistent estimator (TREATREG procedure in STATA). The results (not reported) show that the coefficient of DCAP is negative and significant at the 5% level, consistent with the finding reported in table 7.

## **6.6. Alternative Explanations of the Results**

To the extent that software development projects undertaken by capitalizers have higher expected cash flows than those of expensers, one may argue that, *ceteris paribus*, capitalizers

will tend to have a higher offer price than expensers. However, as long as investors in the stock (once it becomes traded) assign capitalized SDC the same value as those who set the offer price, the closing price of the first trading day should also reflect capitalized SDC accordingly. As a result, the higher offer price would not translate into a lower underpricing of capitalizers.

A somewhat related argument is that expensers, because of their lower perceived quality, have to entice investors by a greater discounting of the offer price, hence a greater observed underpricing. While this argument has an intuitive appeal, it is inconsistent with the existing IPO theories. For example, several IPO underpricing models that explain underpricing as stemming from quality signaling (e.g., Grinblatt and Hwang (1989)), predict that high-quality firms would discount their offer price more than low-quality firms.<sup>22</sup>

While we make a concerted effort in our analyses to enhance the confidence in our interpretation that the accounting treatment affects underpricing, we cannot rule out completely the possibility of alternative explanations.

## **7. Concluding Remarks**

The paper tests the incremental information conveyed by the firm's SDC capitalization decision in an IPO setting. One of the phenomena associated with IPOs is their underpricing. A common explanation for the IPO underpricing is information asymmetry between insiders (management, owners) and potential investors in the IPO. The paper posits that because capitalization conveys to the market the management's beliefs on the distribution of expected cash flows, capitalizing SDC reduces the degree of information asymmetry relative to that prevailing when expensing is chosen and, hence, reduces IPO underpricing.

Our analyses show that the accounting treatment regarding SDC capitalization materially affects underpricing. This is consistent with the notion that the information conveyed by management capitalization decision reduces information asymmetry. The paper shows that a reduction in information asymmetry can be achieved through the option to capitalize SDC. Such an option is unavailable however in situations where a single accounting treatment is dictated by GAAP.

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<sup>22</sup> The economic intuition behind this prediction is that the cost of signaling quality through discounting the offer price can be recouped by the owners of high quality firms through subsequent issues in the seasoned market once the high quality is revealed in the post-IPO market. Since underpricing is more costly to low quality firms, it deters low quality issuers from mimicking high quality issuers, resulting in a separating equilibrium.

The finding on the information content of the SDC accounting treatment suggests that allowing accounting alternatives results in more informative reporting that reduces the firms' cost of capital. Recent attempts by software companies and software industry groups to return to expense-only regime would deprive investors of valuable information that would otherwise have to be obtained by arguably more costly and less efficient search by individual investors. As such, it would likely increase the cost of capital of firms that currently apply SFAS 86.

We conclude with a caveat. Our findings do not imply that it is always optimal for the firm to choose the capitalization treatment of SDC. Since capitalization of SDC is subject to certain conditions and is also constrained by auditors and underwriters, it is not an entirely discretionary choice. To the extent that the firm has some latitude in choosing the accounting alternatives, it would rationally take into account their respective benefits and costs that differ across firms. It is conceivable that for some firms the costs of capitalization (e.g., revelation of proprietary information and high political costs) outweigh its benefits. As discussed in section 4.1.2, our research design, consistent with the existing studies (e.g., Aboody and Lev (1998) and Mohd (2005)), incorporates the endogenous nature of the accounting choice.

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**Table 1****Panel A: Sample Distribution by Year and Accounting Treatment**

Year	NO. of IPOs	Capitalizers (%)	Expensers (%)
1986	17	64.71	35.29
1987	10	100.00	0.00
1988	7	85.71	14.29
1989	11	63.64	36.36
1990	8	87.50	12.50
1991	17	88.24	11.76
1992	26	57.69	42.31
1993	27	59.26	40.74
1994	29	65.52	34.48
1995	69	42.03	57.97
1996	88	27.27	72.73
1997	47	40.43	59.57
1998	34	32.35	67.65
All Years	390	48.46	51.54

**Panel B: Sample Distribution by 4-digit SIC and Accounting Treatment**

Industry (4-Digit SIC)	NO. Of IPOs	Capitalizers (%)	Expensers (%)
Computer Programming Services (7371)	49	53.06	46.94
Prepackaged Software (7372)	264	46.21	53.79
Computer Integrated System Design (7373)	63	50.79	49.21
Computer Processing and Data Preparation (7374)	14	64.29	35.71
All Industries	390	48.46	51.54

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers.

**Table 2****Panel A: Effect of Capitalizing Software Costs on the Financial Statements**

	Rate of Capitalization (%)	% Effect on Net Income	% Effect on Book Value of Equity	% Effect on Total Assets
Mean	21.50	10.46	9.64	6.76
Median	16.28	5.74	4.14	3.19
Cross-sectional Std Dev	20.57	70.12	15.59	13.24

**Panel B: Descriptive Statistics of Capitalization-Related Variables**

	BV <sup>exc</sup>	NI <sup>exc</sup>	CAP-SDC	EXP-SDC	SDCASSET
Mean	30.28	8.07	1.19	5.41	2.17
Median	25.54	6.28	0.70	3.72	0.97
Cross-sectional Std Dev	23.89	10.48	1.63	5.28	4.04

The sample consists of 189 IPOs issued from 1986 to 1998 that capitalized software development costs in the IPO year. Accounting variables are measured for the first fiscal year of the IPO. All variables in Panel A are expressed in millions of dollars and inflation-adjusted to March 1996 price level using CPI.

BV<sup>exc</sup> is the book value of the equity at yearend excluding the capitalized SDC asset.

NI<sup>exc</sup> is the annual net income from continuing operations excluding the expense items relating to software development.

CAP-SDC is the amount of annual SDC capitalized during the IPO year.

EXP-SDC is the amount of annual SDC expensed during the IPO year.

INSIDE is the percentage of the shares retained by the owners at the end of the IPO.

SDCASSET is the cumulative amount of SDC capitalized (net of SDC amortization) reported on the balance sheet at the end of the first fiscal year after the IPO.

Rate of Capitalization is the ratio of the annually capitalized software development costs (SDC) to the total annual SDC (amount capitalized plus amount expensed). Net income is net income from continuing operations before extraordinary items and cumulative effect. The effect of capitalization on net income, book value of the equity and total assets is computed in each case as the difference between the reported value of the variable and its hypothetical value assuming all SDC are expensed as incurred, divided by the hypothetical value of the variable.

**Table 3**  
**Descriptive Statistics for Selected Variables, by Accounting Treatment**

	Mean			Median		
	Capitalizers	Expensers	P-value (t Test)	Capitalizers	Expensers	P-value (Wilcoxon Test)
INTENS (SDC intensity)	0.07	0.05	0.00	0.06	0.04	0.00
PROC (IPO proceeds in \$mil.)	32.96	34.47	0.60	28.00	31.78	0.07
MVE (market value of equity)	178.58	362.27	0.01	105.51	141.39	0.00
ASSETS (total assets in \$mil.)	55.61	57.27	0.86	36.49	41.42	0.38
SALES (sales in \$mil.)	54.70	37.81	0.11	30.06	25.57	0.02
PROFIT (net margin)	-0.09	-0.48	0.01	0.08	0.05	0.00
ROA (return on assets)	-0.02	-0.09	0.09	0.07	0.03	0.00
LEV (leverage)	0.022	0.016	0.24	0.003	0.000	0.07
AGE ( firm age)	8.81	7.11	0.00	8	6	0.00
AUDITOR (auditor dummy)	0.95	0.95	0.75	1	1	0.75
REPUT (underwriter reputation)	6.73	6.76	0.92	8.75	8.75	0.21
INSIDE (Insider Ownership, %)	68.53	71.57	0.04	69.88	73.37	0.00
STD (return variability)	4.69	5.27	0.00	4.29	5.14	0.00
INVPRC (inverse of offer price)	0.10	0.10	0.53	0.09	0.08	0.40
VC (venture capitalist backing)	0.66	0.71	0.29	1	1	0.29
PREVISION (offer price revision)	1.75	1.53	0.00	2	2	0.00

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers. Accounting variables are measured for the fiscal year of the IPO. P-values are two-tailed.

**Variable Definition:**

*INTENS*: annual SDC (amount expensed plus amount capitalized) over firm's equity value, measured at offer price.

*PROC*: offer price multiplied by total number of shares offered (primary plus secondary shares)

*MVE*: market value of equity measured as total shares outstanding after IPO multiplied by first trading day closing price.

*ASSETS*: total assets in \$ million, excluding capitalized software assets.

*SALES*: annual net sales in \$ million.

*PROFIT*: Net income excluding software capitalization and amortization effects over sales.

*ROA*: Net income excluding software capitalization and amortization effects over total assets excluding capitalized software costs.

*LEV*: long-term debt over total assets excluding capitalized software assets.

*AGE*: firm age, measured as the number of years from date of incorporation to IPO issuance date.

*AUDITOR*: a binary dummy variable, equal to 1 if an issuer is audited by a Big-Eight accounting firm and 0 otherwise.

*REPUT*: a ranking measure of underwriter reputation, on a scale of 0 to 9, where 0 (9) represents the least (most) reputable underwriter. The measure was developed by Carter and Manaster (1990).

*INSIDE*: percent ownership retained by insiders.

*STD*: standard deviation of daily return (in percentage) estimated over a period of 200 trading days commencing five trading days after the IPO.

*INVPRC*: the inverse of IPO offer price.

*VC*: a binary dummy variable, equal to 1 if an issuer has venture capital backing and 0 otherwise.

*PREVISION* is a measure of revision in offer price, equal to zero, one or two if the offer price is below, within, or above the initial offer price range in the IPO prospectus filed with the SEC.

MVE, total assets, Sales, and IPO proceeds are inflation-adjusted to March 1996 price level using the CPI. .

**Table 4 Pearson Correlation Matrix for Selected Variables (Two-tailed p-values are in parentheses)**

	DCAP	CAP-RATE	INTENS	PROC	PROFIT	LEV	AGE	AUDITOR	INVPRC	VC	REPUT	STD	INSIDE	PREVISION
UNDER	-0.18 (0.00)	-0.19 (0.00)	-0.25 (0.00)	0.18 (0.00)	0.07 (0.16)	-0.13 (0.01)	-0.21 (0.00)	0.02 (0.65)	-0.25 (0.00)	0.01 (0.88)	0.17 (0.00)	-0.01 (0.81)	0.25 (0.00)	0.20 (0.00)
DCAP		0.41 (0.00)	0.16 (0.00)	-0.03 (0.60)	0.14 (0.01)	0.06 (0.24)	0.16 (0.00)	0.02 (0.90)	0.03 (0.53)	-0.05 (0.29)	-0.01 (0.92)	-0.18 (0.00)	-0.11 (0.04)	0.16 (0.00)
CAP-RATE			0.41 (0.00)	-0.17 (0.00)	-0.03 (0.59)	0.15 (0.01)	0.09 (0.14)	0.07 (0.22)	0.12 (0.04)	-0.03 (0.60)	-0.05 (0.44)	-0.22 (0.00)	-0.11 (0.00)	0.27 (0.00)
INTENS				-0.22 (0.00)	-0.13 (0.01)	0.10 (0.05)	0.12 (0.02)	0.07 (0.15)	0.17 (0.00)	0.07 (0.18)	-0.10 (0.04)	-0.09 (0.09)	-0.36 (0.00)	-0.05 (0.37)
PROC					0.14 (0.00)	-0.00 (0.98)	0.09 (0.07)	0.19 (0.00)	-0.48 (0.00)	-0.03 (0.60)	0.31 (0.00)	-0.14 (0.01)	0.20 (0.00)	0.08 (0.10)
PROFIT						-0.25 (0.00)	0.12 (0.01)	0.27 (0.00)	-0.30 (0.00)	0.10 (0.05)	0.27 (0.00)	-0.27 (0.00)	0.18 (0.00)	0.07 (0.16)
LEV							-0.08 (0.11)	0.04 (0.42)	0.12 (0.02)	-0.08 (0.12)	-0.06 (0.22)	0.13 (0.01)	0.03 (0.66)	-0.05 (0.29)
AGE								0.09 (0.08)	-0.05 (0.28)	-0.11 (0.03)	0.08 (0.13)	-0.09 (0.09)	-0.05 (0.37)	-0.09 (0.08)
AUDITOR									-0.45 (0.00)	0.22 (0.00)	0.32 (0.00)	-0.17 (0.00)	0.12 (0.02)	0.15 (0.00)
INVPRC										-0.23 (0.00)	-0.48 (0.00)	0.25 (0.00)	-0.20 (0.00)	-0.24 (0.00)
VC											0.30 (0.00)	-0.06 (0.21)	0.10 (0.06)	0.13 (0.01)
REPUT													0.29 (0.00)	0.23 (0.00)
STD														-0.29 (0.00)
INSIDE														0.04 (0.40)

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers.

UNDER is the percentage appreciation from offer price to the closing price of first trading day adjusted for contemporaneous market index return.

DCAP is a dummy variable that receives the value 1 if the firm capitalizes its SDC and 0 otherwise.

CAP-RATE is SDC capitalization intensity, measured as the annually capitalized SDC (zero for expensers) over market value measured at offer price, multiplied by 100.

All the other variables are defined as in Table 3.

**Table 5****Panel A. Distribution Statistics on Initial Underpricing for Capitalizers and Expensers (%)**

	<u>Full Sample</u>	<u>Capitalizers</u>	<u>Expensers</u>	<u>P-value*</u>
<b>N</b>	390	189	201	
<b>Mean</b>	23.69	18.28	28.77	0.00
<b>Median</b>	14.90	10.88	18.98	0.00
<b>1st Quartile</b>	2.65	2.11	5.35	
<b>3rd Quartile</b>	34.67	28.43	41.23	
<b>Standard Deviation</b>	28.99	21.74	33.71	

**Panel B. Mean Underpricing for Capitalizers and Expensers by Firm Characteristics (%)**

<b>Firm Characteristic</b>	<u>Full Sample</u>	<u>Capitalizers</u>	<u>Expensers</u>	<u>P-value*</u>
	N=390	N=189	N=201	
<b>Software Development Intensity (INTENS)</b>				
Low	34.86	28.67	38.63	0.03
High	12.57	11.10	14.46	0.22
<b>Issue Proceeds (PROC)</b>				
Small	14.04	11.86	16.48	0.09
Large	33.33	25.98	39.14	0.00
<b>Market Value of Equity (MVE)</b>				
Small	12.31	11.35	13.49	0.38
Large	35.07	27.53	40.42	0.01
<b>Underwriter Reputation (REPUT)</b>				
Low	17.59	15.41	19.77	0.16
High	31.57	22.28	39.64	0.00
<b>Inside Ownership (INSIDE)</b>				
Low	18.57	17.96	19.30	0.71
High	28.81	18.71	36.13	0.00
<b>Standard Deviation of Daily Returns (STD)</b>				
Low	21.93	19.57	25.12	0.12
High	25.44	16.41	31.33	0.00
<b>Profitability (PROFIT)</b>				
Low	23.47	17.08	28.52	0.01
High	23.90	19.29	29.06	0.01
<b>Leverage (LEV)</b>				
Low	25.15	18.68	30.25	0.00
High	22.23	17.96	27.01	0.03
<b>Firm Age (AGE)</b>				
Low	28.90	21.37	34.09	0.00
High	17.85	15.82	20.55	0.19

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers. Small/Low (Large/High) refer to being below (above) the median value of the respective distribution for the full sample of 390 IPOs.

IPO underpricing is defined as the percentage appreciation from offer price to the closing price of first trading day adjusted for contemporaneous market index return. See Table 3 for the other variable definitions.

\*T and Wilcoxon tests are applied to the mean and median differences between capitalizers and expensers, respectively. P-values are two-sided.

**Table 6**  
**Capitalization Intensity on Firm Attributes: Summary Results from TOBIT Estimation of Regression (4):**

$$\text{CAP-RATE} = \delta_0 + \delta_1 \text{PROC} + \delta_2 \text{PROFIT} + \delta_3 \text{INTENS} + \delta_4 \text{LEV} + \delta_5 \text{AGE} + \delta_6 \text{AUDITOR} + \varepsilon$$

(two-tailed p-values in parentheses)

$\delta_0$	$\delta_1$	$\delta_2$	$\delta_3$	$\delta_4$	$\delta_5$	$\delta_6$
-0.55 (0.54)	-0.54 (0.00)	0.32 (0.02)	16.11 (0.00)	5.93 (0.02)	0.34 (0.11)	0.18 (0.80)

Where

*CAP-RATE* is SDC capitalization intensity, measured as the annually capitalized SDC (zero for expensers) over market value measured at offer price, multiplied by 100.

*PROC* is the natural logarithm of the offer price multiplied by total number of shares offered (in millions).

*PROFIT* is net income (excluding software capitalization and amortization effects) over sales.

*INTENS* is the annual SDC (amount expensed plus amount capitalized) over firm value measured at offer price.

*LEV* is long-term debt over total assets excluding capitalized software assets.

*AGE* is the natural logarithm of one plus firm age, where firm age is measured as the number of years from date of incorporation to IPO issuance date.

*AUDITOR* is a binary dummy variable, equal to 1 if an issuer is audited by a Big-Eight accounting firm and 0 otherwise.

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers. Accounting variables are measured for the fiscal year of the IPO.

*PROC* is inflation-adjusted to March 1996 price level using CPI.

**Table 7**  
**Summary Results from Estimating Regression (1):**

$$\text{UNDER} = \delta_0 + \delta_1 \text{DCAP} + \delta_2 \text{PROC} + \delta_3 \text{REPUT} + \delta_4 \text{STD} + \delta_5 \text{INSIDE} + \delta_6 \text{AGE} + \delta_7 \text{AUDITOR} + \delta_8 \text{VC} + \delta_9 \text{INVPRC} \\ + \delta_{10} \text{PREVISION} + \delta_{11} \text{PRECAP-RATE} + \varepsilon$$

(t-values in parentheses)

$\delta_0$	$\delta_1$	$\delta_2$	$\delta_3$	$\delta_4$	$\delta_5$	$\delta_6$	$\delta_7$	$\delta_8$	$\delta_9$	$\delta_{10}$	$\delta_{11}$	Adj. R <sup>2</sup>
16.01	-8.00	2.77	0.25	0.84	0.29	-6.39	-9.40	-4.60	-83.27	8.12	-4.82	0.19
(0.82)	(-2.86)	(0.85)	(0.51)	(0.92)	(2.90)	(-2.93)	(-1.33)	(-1.51)	(-1.87)	(3.69)	(-1.76)	

Where

UNDER is the percentage appreciation from offer price to the closing price of the first trading day adjusted for contemporaneous market index return.

DCAP is a dummy variable that receives the value 1 if the firm capitalizes its SDC and 0 otherwise.

PROC is the natural logarithm of the offer price multiplied by total number of shares offered (in millions).

REPUT is a ranking measure of underwriter reputation, on a scale of 0 to 9, where 0 (9) represents the least (most) reputable underwriter. This measure was developed by Carter and Manaster (1990).

STD is the standard deviation of 200 trading daily returns (in percentage) commencing 5 days after the offer.

INSIDE is the percent ownership retained by insiders by the end of the IPO.

AGE is the natural logarithm of one plus the firm age, where firm age is measured as the number of years from date of incorporation to IPO issuance date.

AUDITOR is a binary dummy variable, equal to 1 if an issuer is audited by a Big-Eight accounting firm and 0 otherwise.

VC is a binary dummy variable, equal to 1 if an issuer has venture capital backing and 0 otherwise.

INVPRC is the inverse of offer price.

PREVISION is a measure of revision in offer price, equal to zero, one or two if the offer price is below, within, or above the initial offer price range in the IPO prospectus filed with the SEC.

PRECAP-RATE is the predicted value of capitalization intensity from regression model (4) as detailed in Table 7.

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers.

Accounting variables are measured for the fiscal year of the IPO.

PROC is inflation-adjusted to March 1996 price level using CPI.

**Table 8**  
**Summary Results from Estimating Regression (2):**

$$\text{UNDER} = \delta_0 + \delta_1 \text{CAP-RATE} + \delta_2 \text{PROC} + \delta_3 \text{REPUT} + \delta_4 \text{STD} + \delta_5 \text{INSIDE} + \delta_6 \text{AGE} + \delta_7 \text{AUDITOR} + \delta_8 \text{VC} + \delta_9 \text{INVPRC} + \delta_{10} \text{PREVISION} + \varepsilon$$

(t-values in parentheses)

$\delta_0$	$\delta_1$	$\delta_2$	$\delta_3$	$\delta_4$	$\delta_5$	$\delta_6$	$\delta_7$	$\delta_8$	$\delta_9$	$\delta_{10}$	Adj. R <sup>2</sup>
-4.62	-1.96	7.19	-0.12	0.13	0.08	-5.65	1.37	-6.04	-1.97	6.87	0.13
(-0.22)	(-2.30)	(2.25)	(-0.21)	(0.13)	(0.71)	(-2.34)	(0.17)	(-1.81)	(-0.05)	(2.40)	

Where

UNDER is the percentage appreciation from offer price to the closing price of the first trading day adjusted for contemporaneous market index return.  
 CAP-RATE is the annually capitalized SDC over market value measured at offer price, multiplied by 100.  
 PROC is the natural logarithm of the offer price multiplied by total number of shares offered (in millions).  
 REPUT is a ranking measure of underwriter reputation, on a scale of 0 to 9, where 0 (9) represents the least (most) reputable underwriter. This measure was developed by Cater and Manaster (1990).  
 STD is the standard deviation of 200 trading daily returns (in percentage) commencing 5 days after the offer.  
 INSIDE is the percent ownership retained by insiders by the end of the IPO.  
 AGE is the natural logarithm of one plus the firm age, where firm age is measured as the number of years from date of incorporation to IPO issuance date.  
 AUDITOR is a binary dummy variable, equal to 1 if an issuer is audited by a Big-Eight accounting firm and 0 otherwise.  
 VC is a binary dummy variable, equal to 1 if an issuer has venture capital backing and 0 otherwise.  
 INVPRC is the inverse of offer price.  
 PREVISION is a measure of revision in offer price, equal to zero, one or two if the offer price is below, within, or above the initial offer price range in the IPO prospectus filed with the SEC.

The sample consists of 189 IPOs issued from 1986 to 1998 that capitalized software development costs in the IPO year.  
 Accounting variables are measured for the fiscal year of the IPO.  
 PROC is inflation-adjusted to March 1996 price level using CPI.

**Table 9**  
**Summary Results from Estimating Regression (3):**

$$\text{UNDER} = \delta_0 + \delta_1 \text{DCAP} + \delta_2 \text{DCAP} * \text{DINTENS} + \delta_3 \text{DINTENS} + \delta_4 \text{PROC} + \delta_5 \text{REPUT} + \delta_6 \text{STD} + \delta_7 \text{INSIDE} + \delta_8 \text{AGE} \\ + \delta_9 \text{AUDITOR} + \delta_{10} \text{VC} + \delta_{11} \text{INVPRC} + \delta_{12} \text{PREVISION} + \delta_{13} \text{PRECAP-RATE} + \varepsilon$$

(t-values in parentheses)

$\delta_0$	$\delta_1$	$\delta_2$	$\delta_3$	$\delta_4$	$\delta_5$	$\delta_6$	$\delta_7$	$\delta_8$	$\delta_9$	$\delta_{10}$	$\delta_{11}$	$\delta_{12}$	$\delta_{13}$	Adj. R <sup>2</sup>
9.21	-15.64	10.46	4.02	2.69	0.20	0.82	0.35	-6.02	-9.61	-3.79	-82.71	8.46	-5.53	0.19
0.47	-3.40	2.09	0.71	0.81	0.40	0.90	3.28	-2.68	-1.36	-1.22	-1.86	3.84	-0.94	

Where:

UNDER is the percentage appreciation from offer price to the closing price of the first trading day adjusted for contemporaneous market index return.

DCAP is a dummy variable that receives the value of 1 if the firm capitalizes its SDC and 0 otherwise.

DINTENS is a dummy variable that receives the value of 1 if the ratio of the total annual SDC to the firm's equity value is below the top quartile of the distribution of this ratio and 0 otherwise.

PROC is the natural logarithm of the offer price multiplied by total number of shares offered (in millions).

REPUT is a ranking measure of underwriter reputation, on a scale of 0 to 9, where 0 (9) represents the least (most) reputable underwriter. This measure was developed by Cater and Manaster (1990).

STD is the standard deviation of 200 trading daily returns (in percentage) commencing 5 days after the offer.

INSIDE is the percent ownership retained by insiders by the end of the IPO.

AGE is the natural logarithm of one plus the firm age, where firm age is measured as the number of years from date of incorporation to IPO issuance date.

AUDITOR is a binary dummy variable, equal to 1 if an issuer is audited by a big-8 accounting firm and 0 otherwise.

VC is a binary dummy variable, equal to 1 if an issuer has venture capital backing and 0 otherwise.

INVPRC is the inverse of offer price.

PREVISION is a measure of revision in offer price, equal to zero, one or two if the offer price is below, within, or above the initial offer price range in the IPO prospectus filed with the SEC.

PRECAP-RATE is the predicted value of capitalization intensity from regression model (4).

The sample consists of 390 software IPOs issued from 1986 to 1998 in which 189 are capitalizers and 201 are expensers.

Accounting variables are measured for the first fiscal year of the IPO. PROC is inflation-adjusted to March 1996 price level using CPI.