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Seasoned Equity Offerings, Valuation and Timing: Evidence from 1980's and 1990's

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While the existing literature has focused on whether firms issue equity when they are overvalued, this paper examines whether there was a better time to issue seasoned equity when the valuation of a firm's shares might have been even more favorable. Using three valuation approaches, the findings suggest that: (1) the valuation of firms issuing seasoned equity is the most favorable at the time of the offering and (2) the estimated valuation errors are significantly related to the probability that firms will undertake a seasoned equity issue. These results are consistent with firms optimizing the timing of the seasoned equity offering so as to take maximum possible advantage of misvaluation of their shares.

Keywords: Seasoned equity offering; timing; valuation.

1. Introduction

Lucas and McDonald (1990) extend the Myers and Majluf (1984) model and show that a firm with undervalued stock tends to delay issuing equity until its stock price rises to its fair value. Thus, when managers have private information about the firm value, they will postpone the equity offering to a time when the valuation of the stock improves. Even though the idea of timing is not new to the equity offering literature, the question of whether there was a better time for a firm to issue seasoned equity has not been studied.

This paper studies to what extent firms are able to time the equity offering when the overvaluation is the largest. Based on the assumption of asymmetric information about expected earnings, I use three earnings-based

valuation models to estimate the value of a firm's stock at various times around the seasoned equity offering (SEO). The three valuation approaches are: (1) industry price to earnings ratio, (2) valuation based on a residual income model (Ohlson, 1990) and (3) valuation based on a model derived by Bakshi and Chen (2005). For each model, the estimated intrinsic value is compared to the prevailing market price. The difference between the two is an estimate of misvaluation, and as such proxies for the valuation divergence exists between managers and the market. This paper investigates whether this divergence is the most extreme at the time of the offering.

There is an extensive empirical evidence that on average firms are selling overvalued seasoned equity: (1) negative announcement effect of 2–3% for US SEOs,[1] (2) followed by poor post-SEO stock performance[2] and (3) optimism of (lead) analysts about future earnings of firms issuing equity.[3] DeAngelo *et al.* (2010) argue that while market timing may play an ancillary role in equity issuance decision, firms issue seasoned equity because they would run out of cash. In recent study, Dong *et al.* (2012) provide evidence that equity issuance is positively related to equity overvaluation, however, only among overvalued firms. However, the question of whether there was a better time to issue equity, when the level of overvaluation might have been more extreme, has not been explored.

As a first test of whether firms attempt to time their equity offering to take advantage of time-varying misvaluation, we compare the valuation levels in years around the SEO. The results show that SEO firms' estimated misvaluation increases up to the equity offering and drifts down in the post issue period. This pattern holds even after controlling for well-known stock price movement around the SEO and for firm's growth opportunities. The second test involves assessing the economic importance of valuation level for firms' financial behavior. Logit regression modeling the probability of an SEO shows that the degree of misvaluation predicts a firm's decision to issue seasoned equity even after controlling for other firm characteristics. We conclude that, overall, the results are consistent with misvaluation of firms' equity playing an important role in corporate financing choices. This conclusion is in contrast to previous findings of Jung *et al.* (1996), Hansen and

[1] See, for example, Asquith and Mullins (1986), Masulis and Korwar (1986), Korajczyk *et al.* (1991), Bayless and Chaplinsky (1996), Choe *et al.* (1993) and others.
[2] See, for example, Loughran and Ritter (1995), Spiess and Affleck-Graves (1995), Ahn and Shivdasani (1999) and others.
[3] See Dechow *et al.* (1999b) and Lin and McNichols (1998). Michaely and Womack (1999) and Rajan and Servaes (1997) report closely related results for IPO firms.

Sarin (1998) and DeAngelo *et al.* (2010) who argue that the timing motivation of equity issues is not a key driver of SEO activity.

While we find support for the hypothesis that firms issue equity to take advantage of overvaluation, a small portion of firms in the sample (about 6–15%) appears to issue equity when they are undervalued. Analysis of this subsample suggests that undervalued issuers experience less negative reaction around the filing date of the SEO. Undervalued issuers are also older and larger firms that issue proportionately less equity, have higher leverage, lower interest coverage, and lower operating income at the time of the offering. That is, these firms appear financially constrained and have lower information asymmetry.

The rest of the paper is organized as follows: Section 2 motivates the timing hypothesis and reviews existing literature. In Sec. 3, the methodology and the sample of SEOs are described. Section 4 presents the results. In Sec. 5, a subset of undervalued SEO firms is studied. Section 6 discusses the effect of unidentified risk factors on the results and Sec. 7 concludes.

2. Timing of SEOs

We analyze whether firms optimize the timing of their SEO. Specifically, the question of interest is: Do firms time their SEO so as to take maximum advantage of the window of opportunity when their equity is the most overvalued with respect to managers' private information? To answer this question, we analyze the time series patterns of the misvaluation around the equity offering as well as the relation between the misvaluation level and the probability of an SEO. There are two testable predictions of the firm-specific timing hypothesis: (1) firms' estimated misvaluation is the greatest at the time of the offering and (2) the valuation errors have a significant impact on the decision to issue equity.

The closest to studying firm-specific timing of SEOs is Jung *et al.* (1996) who investigate the ability of the pecking-order model, the agency model (Harris and Raviv, 1991), and the timing model to explain firms' debt-equity decisions and the stock price reaction to these decisions. In their approach, Jung *et al.* (1996) use the actual long-term post issue abnormal returns as a proxy for management's assessment of a firm's overvaluation. That is, Jung *et al.* (1996) implicitly assume that management has perfect foresight with respect to the five-year future stock performance and that the full extent of the stock performance over the five-year post-issue period is a proxy for the misvaluation at the time of the offering. They do not find support for the

timing model. The long-run abnormal returns, a proxy for the extent of misvaluation at the time of the offering, are not related to the choice of issuing equity versus debt.

Baker and Wurgler (2000) find that the aggregate dollar share of equity issues relative to the dollar sum of aggregate debt and equity issues for a particular year is a strong contrarian predictor of US stock market performance for a subsequent year. They reach the conclusion that firms time the market component of their return when issuing securities. This result would also be consistent with the firm-specific timing hypothesis proposed in this article if managers have private information only about their firm and if this information is correlated across firms at certain times.

Related literature on earnings manipulation (Teoh *et al.*, 1998; Rangan, 1998) suggests that firms that manage their earnings most aggressively via accruals perform the worst in the five years following the equity offering. This result suggests that a firm, at the time of the offering, might be attempting to influence investors' perception of its future earnings by overstating its earnings in the pre-issue period. Investors' extrapolation of strong future performance would then get reflected in a higher price of the stock at the time of the offering. However, Hansen and Sarin (1998) report that analysts do not get influenced by earnings manipulation and reject the notion that earnings forecasts are unusually favorable around equity offering.[4] To assess the impact of possible earnings manipulation, the results in this paper are also investigated taking into account the extent of earnings management.

Research studying the bias in earnings forecasts around the equity offering (Dechow *et al.*, 1999b; Lin and McNichols, 1998) finds that analysts in general and lead analysts in particular are overoptimistic about a firm's prospects in the post-issue period.[5] While these results are consistent with the notion that firms issue overvalued equity, they do not necessarily imply that firms undertake SEOs when their overvaluation is the largest or that the valuation errors play a significant role in a firm's decision to raise new equity. This paper analyzes these two issues.

[4] Beaver *et al.* (2000) goes further and question the validity of the approaches to measuring earnings manipulation. They raise a question of spurious correlation between accruals and other factors (high growth in sales and earnings), which causes the accruals of equity issuing firms to appear extreme.

[5] Note that Hansen and Sarin (1998) do not find any analysts' overoptimism when they compare the SEO firms' forecast errors to those of similar non-SEO firms.

3. Methodology and Sample Description

We assume the existence of information asymmetry and compare the intrinsic value of a stock based on the managers' private information with the prevailing market price of the stock. The measure of misvaluation for a particular firm is defined as:

$$\text{Estimated misvaluation } (t) = (P(t) - V(t))/P(t), \tag{1}$$

where $P(t)$ is the market price of a stock at time t and $V(t)$ is the estimated intrinsic value of a stock at time t obtained from one of the valuation approaches described in the sections below. Positive estimated misvaluation of 10% suggests that the market stock price is 10% higher than the estimated value and is interpreted as a firm being 10% "overvalued" by the market compared with the model benchmark.

3.1. *Estimates of a stock's fair value*

The intrinsic value of a stock has been a subject of considerable attention. We use three valuation approaches based on earnings. While it is possible to value stocks using other methods than earnings (Kim and Ritter, 1999; Kaplan and Ruback, 1995; Penman and Sougiannis, 1998) provide evidence that valuation techniques based on earnings have lower valuation errors than those based on dividends or cashflows. Following D'Mello and Shroff (1999), we assume that earnings expected by managers equals realized earnings plus mean-zero noise.

The first model used is a comparable firms valuation using three-digit SIC code industry P/E ratios (Kaplan and Ruback, 1995; Kim and Ritter, 1999).[6] The estimated SEO firm's intrinsic value is calculated as a product of industry median P/E ratio and the SEO firm's earnings per share for the following year. This simple valuation approach incorporates contemporaneous market expectation about the industry's future prospects but cannot value companies with negative or zero earnings and industries with negative or zero median P/E ratios.

The second model is a residual income valuation in which the estimated intrinsic value is defined as book value plus a discounted stream of residual earnings.[7] Residual earnings are defined as earnings in excess of required return on book value. Penman (1998) shows that residual income, capital

[6]The appendix provides more detail on all models and their implementation.
[7]See, for example, Preinreich (1938), Edwards and Bell (1961), Peasnell (1982) and Ohlson (1990).

cashflows, and discounted dividend models are equivalent under the assumption of clean surplus accounting (i.e. all earnings are paid out as a dividend or increase the book value). The relatively unrestrictive assumption of clean surplus accounting gives rise to a model which has intuitive appeal — only book value per share and earnings in excess of required return on book value per share are reflected in a stock price (see appendix).

The last model is based on Bakshi and Chen (2005) dynamic earnings per share (EPS) valuation. The model, assumes that a constant fraction of earnings is paid out as dividends and that the growth rate of earnings follows a mean reverting Brownian motion. The resulting valuation formula is not closed-form and requires numerical integration of a double-exponential function (see appendix).

3.2. *Sample*

The initial sample is obtained from Security Data Corporation and comprises all firms that issued seasoned equity between January 1980 and December 1997. We stop our sample in 1997 to avoid the effect of the hot IPO market of 1998–2000, when equity issuance exhibited unusual patterns. We require that all firms have to be listed on CRSP and have the relevant quarterly and annual data in Compustat. Financial institutions and utilities are excluded from the sample since they operate in a regulated environment and their characteristics differ substantially from non-regulated firms. The exclusion of financials and utilities also allows for comparison with other studies. Because the residual income model uses three years of accounting data after the issue date, following Healy and Palepu (1990) all additional issues by the same firm during the subsequent three year period following an SEO that enters the sample are excluded. This exclusion avoids effectively "double counting" of the same SEO firm in the sample and is likely to make the results of this study more conservative (less significant). Due to the different data requirements for various valuation methods, we use three samples throughout the paper. The smallest sample of firms is for the *dynamic EPS model* since the data requirement is the most stringent — all firms have to have quarterly Compustat data for eight quarters prior to and four quarters after the SEO. This sample has 1384 observations. The P/E valuation and residual income valuation samples have 2437 and 2459 firms, respectively.

The temporal distribution of the three samples and characteristics of issuing firms are reported in Table 1. Even though the total number of observations is different for the three samples, all samples exhibit similar time

Table 1. Distribution of SEOs by year.

	P/E valuation sample		Residual income sample		Dynamic EPS process sample	
Year	Number of SEOs	% of sample	Number of SEOs	% of sample	Number of SEOs	% of sample
80	116	4.76	124	5.04	42	3.04
81	115	4.72	115	4.68	37	2.67
82	121	4.97	128	5.21	65	4.70
83	265	10.87	282	11.47	124	8.96
84	52	2.13	49	1.99	23	1.66
85	89	3.65	92	3.74	52	3.76
86	98	4.02	100	4.07	69	4.99
87	104	4.27	99	4.03	59	4.26
88	38	1.56	40	1.63	25	1.81
89	72	2.95	77	3.13	63	4.55
90	57	2.34	62	2.52	44	3.18
91	153	6.28	166	6.75	153	11.06
92	145	5.95	148	6.02	120	8.67
93	206	8.45	198	8.05	131	9.47
94	135	5.54	141	5.73	89	6.43
95	196	8.04	200	8.13	67	4.84
96	258	10.59	236	9.60	116	8.38
97	217	8.90	202	8.22	105	7.59
Total	2437	100.00	2459	100.00	1384	100.00

Note: The sample includes firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded.

patterns. For example, the hot issue market of 1983 is apparent regardless of the sample used — about 9–15% of SEO sample occur during this year. There is a noticeable slowdown in the issue activity in 1984 and 1988–1990, which is consistent with previous studies.

Firm characteristics for the residual income model valuation sample are reported in Table 2.[8] The average issue size is $53 million. While the average SEO firm is profitable and has valuable growth opportunities (as measured by Tobin's Q), the dispersion of these measures is considerable. Consistent with previous studies (Loughran and Ritter, 1995, 1997; Spiess and Affleck-Graves, 1995) is the finding that the mean (median) SEO firm experiences a strong price runup in the 6-month period prior to the issue. The mean (median) raw stock return (momentum) in the six months before the offering is 53% (41%).

[8]The distributions of firm characteristics for the other two samples are qualitatively similar to those in Table 2 and are not reported to conserve space.

Table 2. Distribution of SEO firm characteristics — P/E valuation sample.

Variable ($N = 2459$)	Mean	95th percentile	Median	5th percentile	Std. Dev.
Proceeds ($M)	$52.89	$177.60	$26.10	$4.40	$106.75
Book Value of Assets ($M)	$934.15	$3,503.11	$87.91	$8.59	$4,072.88
Leverage	50.06%	80.57%	52.14%	14.46%	19.96%
Capex/assets	9.67%	30.46%	6.47%	0.93%	10.45%
Op. Inc./Assets	15.19%	32.24%	15.39%	−2.14%	11.83%
Tobin's Q	2.24	5.47	1.66	0.92	1.78
Momentum	52.94%	161.29%	40.58%	−13.46%	72.07%

Note: The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. SIC codes are obtained from Compustat. Capex is capital expenditures. Tobin's Q is (market value of common equity + book value of preferred stock + book value of debt)/book value of assets. Leverage is total debt divided by book value of assets. All accounting and stock variables are measured as close to the month of the issue (but prior to the day of issue). Momentum is the raw return over the six months preceding the SEO.

4. Timing of SEOs

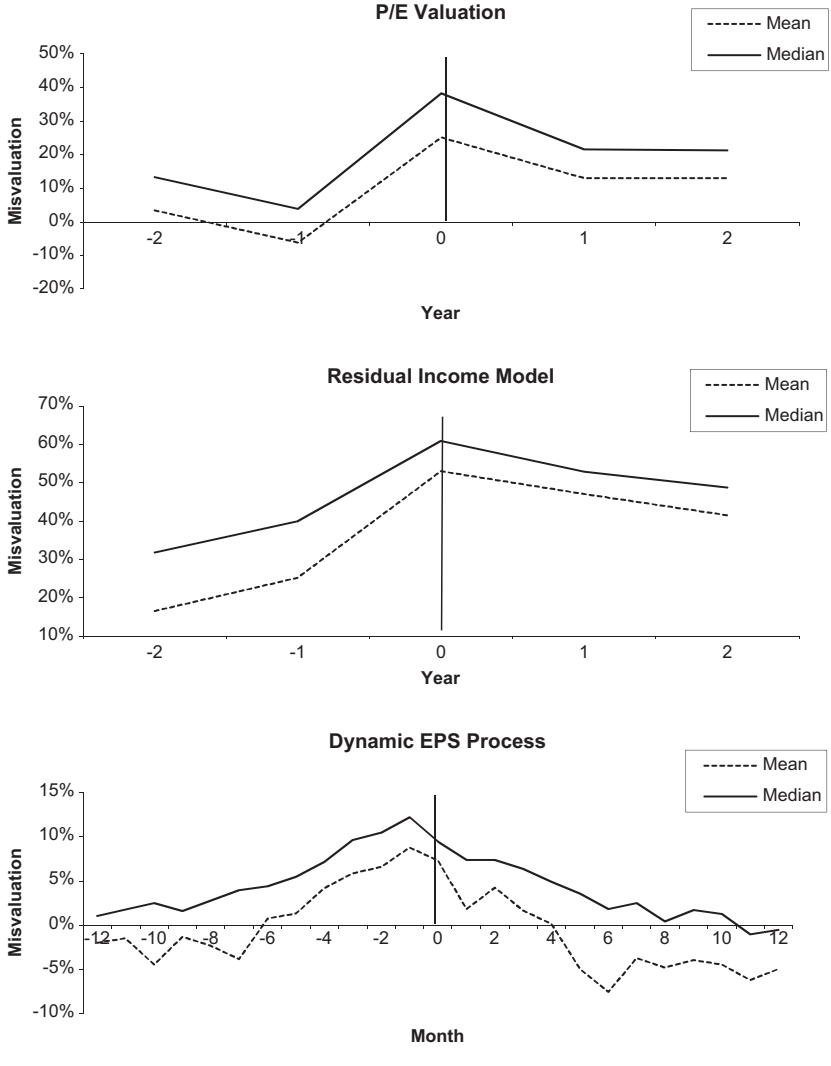
4.1. *Time-series patterns of estimated misvaluation of SEO firms: Univariate analysis*

We show the time trends in average and median estimated misvaluation around the SEO in Fig. 1(a). To control for industry and size effects, we also identify an industry-size matched firms and calculate their misvaluations. Figure 1(b) shows the time series of differences in valuation levels between SEO and industry-size matched non-SEO firms. Regardless of a misvaluation measure used, the valuation level and the difference in valuation level between SEO and non-SEO firms is the largest in the year of the equity issue. Additionally, the results based on the *dynamic EPS model* show that the misvaluation is at its maximum one month before the offering, with the misvaluation falling off sharply in the post offering period.

As shown in Fig. 2, this result reflects more than the previously documented price movement around an SEO — both the announcement effect and the post-issue drift.[9] For ease of comparison both prices and intrinsic values at each point in time are scaled by price and intrinsic value at time zero. The dotted line tracks the stock price performance of firms around equity issuance. It is apparent that the price movement by itself mimics the

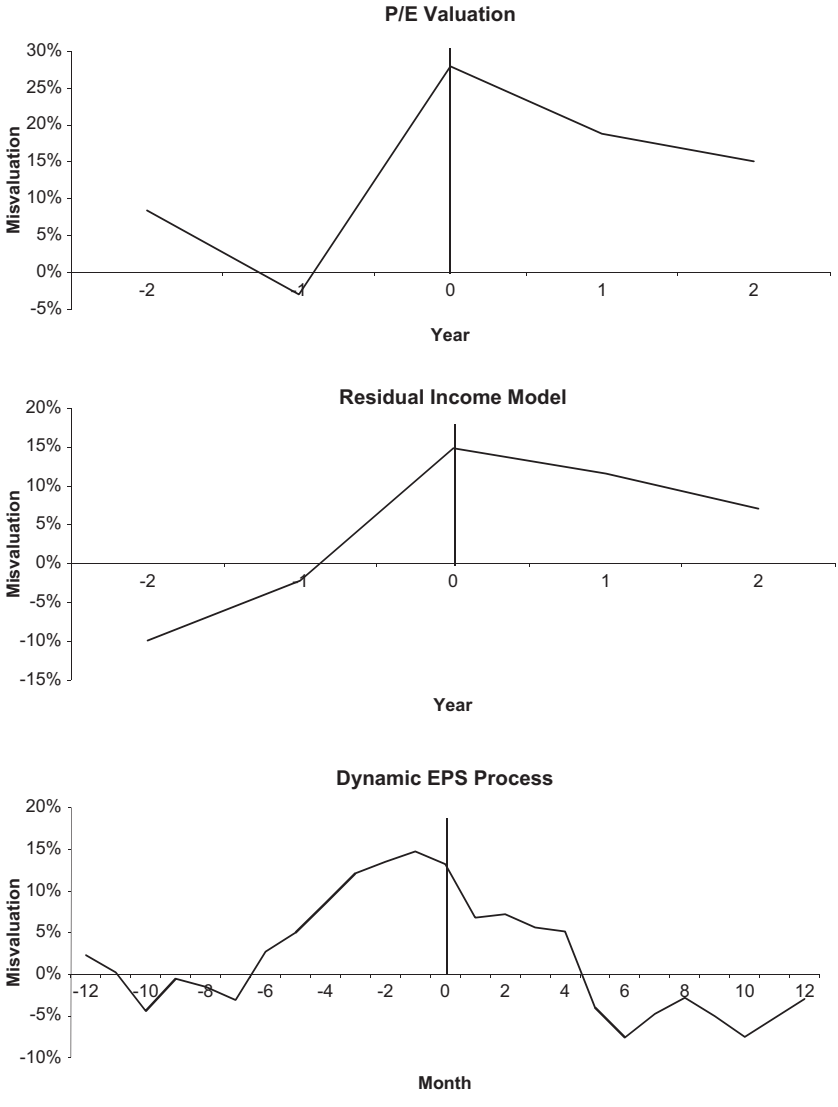
[9]Loughran and Ritter (1997) show a surge in P/E ratio before an SEO. Since earnings are improving up to the time of an SEO and deteriorate starting two quarters thereafter, the documented pattern in P/E ratio is also consistent with the previously documented stock price movement around an SEO.

pattern of misvaluation observed in Fig. 1(a): the stock price increases up to the equity offering and then slowly drifts down in the post offering period. However, the misvaluation patterns are not only a reflection of the stock price movement. Specifically, the estimated intrinsic value measures (solid lines)



(a)

Fig. 1. (a) Misvaluation patterns surrounding the announcement of SEO. The figure shows the misvaluation patterns for SEO firms around the offering. The sample spans 1980–1997. Year 0 is defined as the year of the SEO. (b) Patterns of differences between misvaluation levels of SEO and non-SEO firms. The figure shows the difference of misvaluation patterns for SEO and non-SEO year-industry-size matched firms. The sample spans 1980–1997. Year 0 is defined as the year the SEO.



(b)

Fig. 1. (*Continued*)

are increasing after the offering. Moreover, for the P/E and residual income valuations, the intrinsic value estimates are decreasing up to the time of the offering. These patterns in intrinsic value measures make the pattern in the misvaluation measures more pronounced, suggesting that misvaluation patterns are not only a reflection of stock price changes but also of changes in valuation around the equity offering.

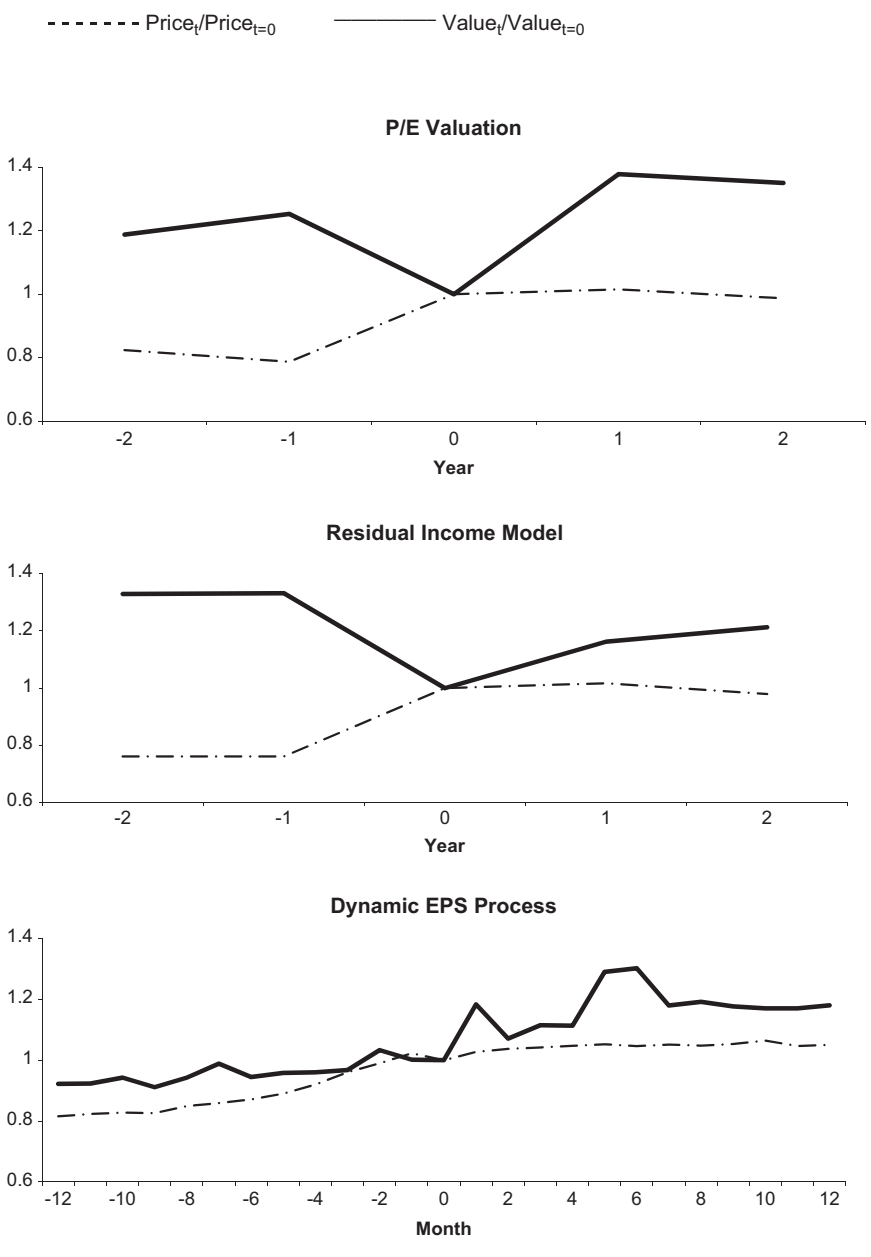


Fig. 2. Patterns of price and value movements for SEO firms. The figure shows the patterns of ratios of price (value) to price at time 0 (value at time zero) over two years surrounding the SEO for each firm averaged across all SEO firms. For dynamic EPS process, the trends in the ratios are shown on monthly basis. The sample spans 1980–1997. Year 0 is defined as the year of the SEO.

Table 3. Valuation of SEO firms over time — Univariate tests.

		Year −1	Year 0	Year 1
P/E valuation	Mean	−11.10%*	26.87%	14.13%*
	Median	2.86%*	37.77%	23.94%*
	(*N*)	(1457)	(2437)	(1841)
Residual Income Model	Mean	28.12%*	57.22%	50.45%*
	Median	44.31%*	66.66%	57.00%*
	(*N*)	(1830)	(2459)	(2251)
Dynamic EPS process	Mean	−1.01%*	10.17%	−6.46%*
	Median	1.20%*	11.86%	−1.03%*
	(*N*)	(1288)	(1384)	(1138)

Note: *Different from mean (median) for year 0 at the 1% level for a two-sample two tailed *t* test (Wilcoxon test for medians).
The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. Misvaluation is calculated as (Market Price — Model Value)/Market Price and is based on P/E valuation, the residual income model, and Bakshi and Chen (2005). Year 0 is the year of the SEO.

In Table 3, we report the mean and median overvaluation levels for all three measures for years −1, 0, and +1 relative to the actual issue. If firms were to issue equity one year earlier, *ignoring the event-induced price change*, they would raise approximately 11–38% less capital solely due to the lower valuation level (i.e. the difference between year 0 and −1 valuation levels). The difference is significant at 1% regardless of measure used. Had the firms issued one year later, they would raise approximately 7–17% less capital due to a lower valuation level. Again, the differences are significant at the 1% level for all misvaluation measures. Thus, consistent with the timing hypothesis, SEO firms appear to be issuing when the overvaluation level peaks.[10]

4.2. *Time-series patterns of estimated misvaluation of SEO firms: Regression analysis*

To answer the question of whether the changes in stock price, future growth opportunities, or other characteristics entirely explain the change in measured misvaluation around the equity offering, the time-series patterns of

[10] Caution should be exercised when interpreting the levels of overvaluation. Some models tend to consistently imply that stocks are overvalued (see, for example, Chang *et al.*, 1999; Lee *et al.*, 1999) regarding results for the residual income model). Therefore, to take into account the fact that the center of the distribution might be off-zero, the absolute level of overvaluation should be studied with respect to an average overvaluation of a control sample. However, since we study the *changes* in misvaluation over time, this issue is not likely to affect our conclusions.

valuation levels of SEO firms are examined in a regression framework. The sample used in the regressions is composed of SEO firms in years –1, 0 and +1. To compare the valuation levels at the three points in time, we define two indicator variables for years +/− 1 relative to the offering. A negative coefficient on indicator variables for year +/− 1 would be consistent with the timing hypothesis. To account for the possibility of understated standard errors due to autocorrelation in the levels of relevant variables, we estimate all regressions on changes of the misvaluation. In these specifications, we include indicator variables for the periods over which the change is measured and test for increase and decrease in estimated misvaluation over time.

If SEO firms are more likely to be "growth" firms with most of their value tied up in long-term earnings growth opportunities, the results in Table 3 might be explained by the changes of the SEO firms' long-term earnings opportunities. This might be due to the fact that all valuation models used are based on short-term earnings performance and would therefore find "growth" firms to be overvalued due to artificially low intrinsic value estimates. We, therefore, include Tobin's Q to control for the effect of future growth opportunities. Tobin's Q is defined as a ratio of market value of equity plus book value of debt to book value of total assets.

Since several studies (Chang *et al.*, 1999; D'Mello and Shroff, 1999, and others) document a size effect for misvaluation measures, we also include the book value of assets. Furthermore, we control for the extent of a firm's asymmetric information in order to account for the precision of the valuation of a firm (see Aboody and Lev, 2000 for discussion). Specifically, we include the ratios of R&D expenditures to sales, dividend to sales, and plant, equipment, and property to total assets as control variables. When studying the *changes* in misvaluation, the *changes* of the above-described variables as well as price change (return) in the six months prior to the measurement of misvaluation are included as control variables.

Table 4 reports the regression results. In Panel A, the estimated coefficients on the year +/−1 indicators are significantly negative for all misvaluation measures. The results for regressions estimated on changes of all variables and stock returns are reported in Panel B. The intercepts, effectively capturing the percentage increase in misvaluation leading up to the SEO, are significantly positive in all regressions. The coefficients on the indicator variables coding for the time period one year after the SEO are all significantly negative. This result is in line with overvaluation increasing in the year prior to issuance and decreasing thereafter.

With respect to the control variables, we note that misvaluation in the years around the equity offering is not perfectly explained by firm's growth opportunities as proxied by Tobin's Q. While the coefficient on Tobin's Q tends to be positive and significant, inclusion of this variable does not

Table 4. Valuation of SEO firms over time — regression analysis.

Independent variable	P/E valuation	Residual income model	Dynamic EPS process
Panel A: Regression on levels			
Intercept	0.07	0.36	0.12
	(0.00)	(0.00)	(0.00)
Year −1 dummy	−0.34	−0.23	−0.12
	(0.00)	(0.00)	(0.00)
Year +1 dummy	−0.11	−0.06	−0.17
	(0.00)	(0.00)	(0.00)
Tobin's Q	0.07	0.11	−0.005
	(0.00)	(0.00)	(0.04)
Dividends/sales	0.06	−0.45	−0.05
	(0.70)	(0.01)	(0.75)
R&D/sales	−0.00	0.01	−0.001
	(0.47)	(0.04)	(0.54)
PPE/assets	0.11	−0.06	0.000
	(0.01)	(0.05)	(0.07)
BV assets $M	−1.94	−8.74	−1.96
	(0.39)	(0.00)	(0.29)
Adjusted R^2	0.078	0.137	0.039
F value	71	149	22
Pr > F	0.00	0.00	0.00
Panel B: Regression on changes			
Intercept	0.37	0.84	0.18
	(0.00)	(0.00)	(0.00)
Year (−1,0) dummy	−0.14	−0.28	−0.15
	(0.00)	(0.00)	(0.00)
6M-Ret	0.25	0.13	0.22
	(0.00)	(0.00)	(0.00)
ΔTobin's Q	0.03	0.001	0.04
	(0.01)	(0.97)	(0.00)
ΔDividends/sales	0.17	0.14	−0.23
	(0.43)	(0.85)	(0.59)
ΔR&D/sales	0.001	0.003	−0.003
	(0.45)	(0.83)	(0.05)
ΔPPE/Assets	−0.41	0.000	0.00
	(0.05)	(0.99)	(0.29)
ΔLn(BV assets)	0.04	−0.06	−0.08
	(0.32)	(0.01)	(0.03)
Adjusted R^2	0.101	0.111	0.113

Table 4. (*Continued*)

Independent variable	P/E valuation	Residual income model	Dynamic EPS process
F value	58	66	42
$\Pr > F$	0.00	0.00	0.00

The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. The dependent variable is misvaluation. Misvaluation is calculated as (Market Price — Model Value)/Market Price and is based on P/E valuation, the residual income model, and Bakshi and Chen (2005). Year +/−1 dummy codes for the year of valuation measurement relative to the SEO. Tobin's Q is (market value of common equity + book value of preferred stock + book value of debt) / book value of assets. PPE is the value of plant, property, and equipment. R&D is the research and development expense. All accounting and stock variables are measured as close to the month of filing (but prior to the day of filing). 6M-Ret, in Panel B, is the raw return for the 6-month period leading up to the month of the measurement of misvaluation. All continuous variables used in estimation are used as real numbers (i.e. 10% is coded as 0.10). p-values are in parentheses. The sample for each sample consists of SEO firms with available information for years −1, 0, and +1 relative to the year of the offering.

eliminate the significance of the dummy variable measuring the valuation levels around the time of the offering. Additionally, the inclusion of changes in a firm's stock price does not affect the previously reached conclusion of misvaluation peaking at the time of the offering. That is, the changes in stock prices do not explain perfectly the changes in valuation levels around the time of the SEO (Panel B). Negative significant coefficient on size is consistent with the previously documented size effect for valuation measures. All other control variables are not reliably different from zero.

To summarize, the results presented in this section are consistent with the timing hypothesis. Firms are issuing seasoned equity when the overvaluation reaches its peak relative to the year prior to and after the actual SEO year.

4.3. *The equity issuance decision: Univariate analysis*

While the results in the previous section suggest that SEO firms are issuing equity when their overvaluation is the greatest, the issue of whether misvaluation influences a firm's decision to issue equity remains unanswered so far. In other words, the result that misvaluation is the greatest at the time of an equity offering does not necessarily mean that the valuation errors play a role in a firm's decision to issue equity.

As documented in previous sections, estimated misvaluation is related to various firm's characteristics. Jung *et al.* (1996) argue that variables reliably

Table 5. Probability of equity issue by valuation level.

	Proportion of equity issuing firms for valuation quartile					
Misvaluation measure	1 (low)	2	3	4 (high)	χ^2 (p-value)	Total
P/E Valuation						
(Avg N SEO)	16	24	41	54		2,437
(Avg N Non-SEO)	520	520	520	520		37,413
%	2.9	4.6	7.7	10.1	<0.01	6.3
Residual Income Model						
(Avg N SEO)	16	25	36	59		2,459
(Avg N Non-SEO)	612	612	612	611		44,041
%	2.9	4.7	7.0	10.8	<0.01	6.4

Note: The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. Misvaluation is calculated as (Market Price — Model Value)/Market Price and is based on P/E valuation, the residual income model, and Bakshi and Chen (2005). Proportion of equity issuing firms is calculated for each year and quartile and then averaged across years. Avg N SEO (Non-SEO) reports the average number of SEO (Non-SEO) firms per year in a particular quartile. χ^2 reports the test of equality of proportions of SEO firms across quartiles.

associated with equity issuance, such as prior stock price performance and Tobin's Q, could also proxy for misvaluation. To get a sense of the economic importance of estimated misvaluation on the decision to issue equity, we sort all SEO and non-SEO firms with available data according to their valuation level and assign them to quartile portfolios. The quartile portfolios are formed each year in order to account for time varying valuation levels. Then for each quartile portfolio each year the proportion of equity issuing firms is calculated and averaged across years.

Table 5 reports the average proportion of equity issuing firms in the four quartile portfolios for each misvaluation measure.[11] The results indicate that a firm in the highest misvaluation quartile is three to four times more likely to issue equity than a firm in the lowest misvaluation quartile. The proportions of equity issuing firms increase monotonically with estimated misvaluation level. The χ^2 test of equality of proportions across the quartiles is rejected at better than 1% level for all samples examined. These results are consistent with equity misvaluation playing an economically important role in a firm's issuance decision.

[11]Results for the dynamic EPS process for all non-SEO firms are not reported due to computational and data availability constraints.

4.4. *The equity issuance decision: Logistic regression*

Previous literature identifies several factors that are significantly related to the decision to issue equity. Jung *et al.* (1996) and Opler and Titman (1996) study firms' debt-equity choice and show that less profitable firms (firms with lower operating income), higher future growth options as proxied by Tobin's Q, and stronger pre-issue stock price performance (higher momentum) are more likely to issue equity. McLaughlin *et al.* (1996) study the equity issuance decision and document that leverage the firm size are also important determinants of the decision to issue. In addition to these variables, we also control for levels of asymmetric information, such as research and development expenses scaled by sales, natural log of book value of assets, and an IPO indicator. IPO indicator is set equal to one if the firm went public during a three year period immediately prior to the SEO and to zero otherwise.

The logistic regression is modeling the probability of an SEO and examines whether the estimated misvaluation is a significant factor in a firm's decision to issue equity. We use two control samples in the logistic analysis to assess the robustness of the results. The first sample comprises all firms with the relevant data. Specifically, the first sample includes all public firms for which the data are available during January 1980 to December 1997. We define an indicator variable INDICATOR which we set equal to zero if a firm did not issue seasoned equity in that particular year and to one otherwise. Effectively, we allow SEO firms in our original sample, to enter the control sample by setting the SEO_INDICATOR to zero for every year with available data except for the year of the SEO.[12] All relevant variables for non-SEO firms are calculated as of the fiscal year end of each year. For SEO firm-years all relevant variables are measured as close to but prior to the issue date as possible. The second control sample is based on a year-industry-size matched firms where industry is defined at the three-digit SIC code. The logit model estimates the effects of previously described variables on the probability of SEO_INDICATOR being equal to one (the probability of an equity issue).

The results using the year-industry-size match control sample are presented in Panel A, while Panel B shows the results using the panel dataset of all non-SEO firm-years control sample. To assess the economic importance of

[12]That is, the SEO firm is allowed to re-enter the control sample immediately the year after the offering. An alternate approach, consistent with long-run return studies, would be to not allow a re-entry of the sample firms into the control subsample for three years after the offering. However, not allowing a re-entry for three years after the offering would make the results only stronger because, as documented in previous sections, the misvaluation steadily decreases over the two years following the issuance.

misvaluation, we also report the marginal effects of misvaluation on the probability of SEO evaluated at the mean (in brackets).

We note that the coefficient on misvaluation is positive and significant at 1% level in all models.[13] The magnitude and significance level is robust to the inclusion of other control variables, most notably momentum, Tobin's Q, and leverage. Furthermore, we note that the marginal effects indicate an economically meaningful effects of misvaluation on probability of SEO. Specifically, in Panel A, the marginal effects range from 12% to 44%. We also note that inclusion of pre-SEO momentum decreases the marginal effect which is not surprising given that mivaluation is affected by stock price changes. However, even after inclusion of pre-SEO offering, the marginal effects remain economically meaningful.

Overall, we conclude that regardless of the control sample or control variables used, we find support for the timing hypothesis. The level of mivaluation not only peaks at the time of the offering but also affects the probability of an SEO.

To summarize, SEO firms issue equity when the misvaluation is the greatest. The valuation errors play an important role in a firm's financing behavior — firms that are more overvalued than a sample of control firms are significantly more likely to issue equity. Overall, we conclude that our findings are consistent with the SEO timing hypothesis.

5. Earnings Management, Insider Trading and Undervalued Issuers

We now examine whether the results supporting the SEO timing hypothesis reflect the known effect of earnings management around SEOs. We also analyze whether insiders trade in a manner that is consistent with them being aware of misvaluation level. Finally, we analyze SEO firms that pursue equity offerings while their shares are undervalued.

5.1. *Does earnings management explain the effect of misvaluation?*

We now analyze whether our conclusions regarding the misvaluation and timing of SEOs are explained by earnings management. Specifically, Teoh *et al.* (1998) and Rangan (1998) show that firms that manage their earnings

[13]The inclusion of misvaluation in years +/−1 in the logistic regression does not materially affect the results reported. Moreover, the coefficients on these two variables are not reliably different from zero.

most aggressively around the SEO experience the worst stock performance over the consequent five years. This result would be consistent with firms managing their earnings around the SEO and in this way timing their issue. Note that under the timing hypothesis, we do not distinguish whether the overvaluation is only due to market stock price movement or due to "borrowing" earnings from the future via earnings management prior to the SEO. However, it is important to analyze whether the misvaluation timing results are purely a reflection of the earnings management around the SEO.

To proxy for earnings management, we follow prior literature and calculate the level of total accruals as in Teoh *et al.* (1998). That is, we define total accruals as net income less cash flows from operations.[14] If misvaluation just reflects the earnings management around the SEO, we expect that total accruals are higher for the SEO firms when compared to non-SEO control

Table 6. Logistic regression analyzing the equity issue decision.

Independent variables	P/E valuation			Residual income model			Dynamic EPS process		
	1	2	3	1	2	3	1	2	3
Panel A: Year-Industry Size Match									
Misvaluation		0.68	0.53		0.42	0.23		1.75	0.87
		(0.00)	(0.00)		(0.00)	(0.01)		(0.00)	(0.00)
		[0.16]	*[0.12]*		*[0.24]*	*[0.15]*		*[0.44]*	*[0.18]*
Momentum	2.06		1.98	2.04		2.01	1.82		1.56
	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)
Leverage	0.21		0.44	−0.11		−0.17	0.17		0.29
	(0.14)		(0.00)	(0.46)		(0.27)	(0.27)		(0.07)
Tobin's Q	−0.04		−0.08	−0.16		−0.18	−0.06		−0.06
	(0.01)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)
Op. Inc./assets	−1.09		−1.13	0.41		0.38	−1.17		−1.07
	(0.00)		(0.00)	(0.15)		(0.18)	(0.00)		(0.00)
R&D/sales	−0.003		−0.003	−0.02		−0.02	−0.01		−0.01
	(0.01)		(0.02)	(0.18)		(0.15)	(0.12)		(0.19)
Ln(assets)	−0.11		−0.12	−0.09		−0.09	−0.06		−0.07
	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)
IPO dummy	0.74		0.73	0.96		0.93	0.83		0.85
	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)
Pseudo R^2	0.250	0.060	0.276	0.270	0.024	0.272	0.193	0.079	0.207
Likelihood ratio	987	218	1,101	1,113	89	1,120	441	172	477
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[14]If cash flow from operations is not available, it is calculated as the funds flow from operations minus current accruals (CA), where CA = Δ[current assets − cash] − Δ[current liabilities− current maturity of long−term debt].

Table 6. (*Continued*)

Independent variables	P/E valuation			Residual income model			Dynamic EPS process		
	1	2	3	1	2	3	1	2	3
Panel B: All Non-SEO Firm-Years									
Misvaluation		0.86	0.71		1.48	0.99			
		(0.00)	(0.00)		(0.00)	(0.00)			
		[0.06]	*[0.04]*		*[0.05]*	*[0.04]*			
Momentum	1.73		1.70	1.62		1.55			
	(0.00)		(0.00)	(0.00)		(0.00)			
Leverage	0.91		1.12	1.20		1.16			
	(0.00)		(0.00)	(0.00)		(0.00)			
Tobin's Q	0.04		−0.01	0.05		−0.03			
	(0.00)		(0.37)	(0.00)		(0.08)			
Op. Inc./assets	−0.21		−0.13	1.14		1.10			
	(0.15)		(0.40)	(0.00)		(0.00)			
R&D/sales	−0.00		0.00	0.00		−0.00			
	(0.99)		(0.70)	(0.90)		(0.93)			
Ln(assets)	−0.01		−0.03	0.08		0.08			
	(0.30)		(0.02)	(0.00)		(0.00)			
IPO dummy	1.17		1.14	0.76		0.65			
	(0.00)		(0.00)	(0.00)		(0.00)			
Pseudo R^2	0.173	0.032	0.193	0.142	0.038	0.154			
Likelihood ratio	2544	459	2842	2232	580	2424			
p-value	0.00	0.00	0.00	0.00	0.00	0.00			

The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. Misvaluation is calculated as (Market Price — Model Value)/Market Price and is based on P/E valuation, the residual income, and Bakshi and Chen (2005). Tobin's Q is (market value of common equity + book value of preferred stock + book value of debt) / book value of assets. Leverage is total debt divided by book value of assets. PPE is the value of plant, property, and equipment. R&D is the research and development expense. All variables are as of the month of filing (but prior to the day of filing). Momentum is 6-month raw return from month −6 till month −1 relative to the month of the issue (SEO firms) or the time of the measurement of misvaluation (non-SEO firms). IPO dummy is set equal to one if within the past three years a firm listed on a stock market. The models for matched sample are estimated without a constant. For Panel B the constant is not reported. p-values are below each coefficient in (parentheses). Marginal effects at the mean are reported below coefficients in [brackets].

sample. Furthermore, we should observe a positive relation between misvaluation and total accruals.

In Panel A of Table 7 we compare total accruals of SEO firms and firms in the control samples. The result show that the total accrual levels for SEO firms are significantly higher than those of non-SEO firms for two out of the three samples used. The exception is the dynamic EPS process sample for which the total accruals are statistically and economically indistinguishable.

Table 7. Misvaluation and earnings management.

Sample	SEO firms	Non-SEO matched sample	All non-SEO firm-years
Panel A: Total accrual levels			
P/E Valuation Sample			
Mean	−2.05%	−3.20%*	−3.58%*
Median	−2.77%	−3.71%*	−3.33%*
Residual Income Sample			
Mean	−1.83%	−3.57%*	−3.47%*
Median	−2.69%	−3.89%*	−3.61%*
Dynamic EPS Process Sample			
Mean	−4.67%	−4.74%	—
Median	−4.35%	−4.51%	—

	Quintile of total accruals					Non-SEO matched sample
	1 (lowest)	2	3	4	5 (highest)	
Panel B: Misvaluation levels by quintiles of total accruals						
Total accruals range	≤ −9.1%	(−9.1, −4.8]	(−4.8, −0.6]	(−0.6, 5.3]	>5.3%	
P/E valuation						
Mean	24.16%	22.72%	28.89%	27.08%	31.14%	−4.37%
Median	38.30%	34.19%	38.14%	36.52%	42.73%	12.35%
Residual income model						
Mean	54.71%	49.51%	53.19%	59.20%	69.16%	38.22%
Median	65.64%	56.71%	60.76%	67.84%	76.51%	51.06%
Dynamic EPS process						
Mean	10.07%	8.41%	10.23%	9.36%	10.27%	−6.32%
Median	12.30%	12.11%	11.64%	11.49%	11.40%	0.36%

Note: * Different from SEO mean (median) at 1% level for a two-tailed tow-sample *t*-test (Wilcoxon test).

The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. Misvaluation is calculated as (Market Price— Model Value)/Market Price and is based on P/E valuation, the residual income model, and Bakshi and Chen (2005). Panel B reports valuation levels for quintiles by total accruals. Total accruals are calculated following Teoh, Welch, and Wong (1998). That is, Total Accruals = Net Income − Cash Flow from Operations. If Cash Flow from Operations is not available, it is calculated as the funds flow from operations minus current accruals (CA). Where CA = Δ [current assets − cash] − Δ [current liabilities − current maturity of long−term debt].

In Panel B of Table 7, we report the average misvaluation for quintiles based on the level of total accruals. We note that the highest accrual quintile has the highest average misvaluation. However, all accrual quintiles have higher misvaluation than the matched non-SEO benchmark firms. Furthermore, the misvaluation does not increase monotonically with total accruals. In untabulated results, we note that inclusion of total accruals in the logit regression does not affect our conclusion about the importance of misvaluation on timing of SEOs.

Overall, we conclude that earnings management can at best explain only part of the overvaluation. Hence, focusing on misvaluation adds unique and important insights into the timing of SEOs.

5.2. *Is insider trading consistent with the misvaluation patterns around the SEO?*

We now examine whether the managers in our sample trade in a way that is consistent with them having private knowledge of the misvaluation levels of their firms. Kahle (2000) and Lee (1997) present evidence that insider trading prior to an SEO is associated with three-year post-offering stock returns of secondary issuers during 1976–1990. Specifically, both studies show that insiders trading direction reflect their private information and predicts future long-run returns. This result is consistent with managers of issuing firms selling overvalued equity.

In untabulated results, we find that the misvaluation is significantly lower for net buyers than for net sellers. This evidence is consistent with insiders selling stocks that they know to be overvalued prior to an SEO. We also examine the changes in insider trading for under- and overvalued firms. We find that, on average insiders of overvalued (undervalued) SEO firms decrease (increase) their net purchases. Again, this pattern of changes in insider trades is consistent with insider taking advantage of their private information about the changing valuation level of their firm by selling (buying) stocks that are seemingly overvalued (undervalued).

Overall, the pattern of insider trading is consistent with insiders having private information about their firm's valuation level prior to an SEO and further supports the SEO timing hypothesis.

5.3. *Undervalued issuers*

While the results presented so far are consistent with the notion that overvaluation of equity plays an important role in a firm's decision to issue equity,

there are firms in the sample that issue equity when they are estimated to be undervalued relative to other non-SEO firms. We now analyze whether financial stress and the level of asymmetric information characteristics are consistent with firms issuing equity when undervalued. Cornett and Tehranian (1994) show that banks in financial distress experience higher abnormal returns upon announcement of equity issue when compared to banks that are not in financial distress. For firms with no asymmetric information, Myers and Majluf (1984) suggest that the lemon premium equals zero. Hence, the lower the asymmetric information, the higher the probability of equity issuance, especially when a firm is financially stressed.

In Panel A of Table 8, we compare the characteristics of undervalued and overvalued SEO firms. Reported results are based on the residual income model misvaluation, however, the results are qualitatively similar regardless of the choice of a valuation measure. In terms of the offer and non-operating firm characteristics, undervalued firms are significantly older and larger companies that issue proportionately less new equity. The undervalued issuers also experience lower momentum in the pre-issue period. Finally, we note that the cumulative abnormal returns at the announcement of the SEO are significantly higher for the undervalued firms when compared to the overvalued firms. These results are consistent with firms with lower asymmetric information issuing equity when undervalued.

In Panel B of Table 8, we analyze the operating characteristics in $+/-3$ years around the SEO. The results show that undervalued relative to overvalued SEO firms have consistently significantly higher leverage and consistently significantly lower interest coverage, quick ratio, and R&D expenditures. For overvalued issuers, interest coverage improves around the offering. However, for undervalued issuers, it exhibits an opposite, U shape, pattern — as a matter of fact, it reaches its lowest point one year prior to the issuance. The quick ratio increases after the offering for both type of issuers but it still remains significantly lower for undervalued issuers. In terms of operating income, the undervalued and overvalued SEO firms are similar up to the year -2, two years prior to the offering. However, between year -2 and the year of the offering, the trends in operating income are different — overvalued firms experience an increase in operating income up to the year of the issue while undervalued firms exhibit a relatively stable level of operating income. In the post-offering period, the operating income improves slightly for the undervalued issuers while it seems to deteriorate for overvalued ones. The first time the undervalued group has significantly higher operating income than the overvalued subsample is two years after the offering. This is consistent with

Table 8. Characteristics of undervalued and overvalued SEO firms.

	Undervalued issuers ($N = 302$)	Overvalued issuers ($N = 2155$)
Panel A: Issue and Other Characteristics as of Year 0		
Age (years)	21	9*
% of IPO	15.6%	41.1%*
BV assets ($M)	$2,723	$683*
Amount ($M)	$61	$52
Amount/BV assets	16%	51%*
Momentum	34.9%	55.4%**
CAR (−5,5)	−1.68%	−3.02%*
CAR (−5,0)	−0.78%	−1.78%*

	Year −3	Year −2	Year −1	Year 0	Year 1	Year 2	Year 3
Panel B: Operating Characteristics around Issuance							
Leverage							
Undervalued	57.4%	56.9%	57.9%	57.3%	52.9%	52.5%	52.3%
Overvalued	53.1%*	53.1%*	54.4%*	49.1%*	41.0%*	44.0%*	46.7%*
Int. coverage							
Undervalued	3.62	3.11	2.91	3.29	3.70	4.96	6.30
Overvalued	3.57	3.96**	3.74**	4.38*	6.36*	6.36**	5.90
Quick ratio							
Undervalued	1.24	1.28	1.22	1.23	1.41	1.45	1.41
Overvalued	2.12*	2.02*	2.04*	2.18*	2.88*	2.45*	2.27*
Dividend/sales							
Undervalued	1.6%	1.6%	1.7%	1.4%	1.5%	1.6%	1.7%
Overvalued	1.0%**	0.9%**	0.9%**	1.0%	0.7%*	1.0%*	0.7%*
R&D/sales							
Undervalued	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%
Overvalued	12.6%*	15.2%*	9.6%*	16.4%*	12.6%*	12.8%*	10.7%*
Oper. Inc./assets							
Undervalued	12.8%	12.6%	12.7%	12.9%	13.4%	14.5%	14.7%
Overvalued	13.1%	14.2%**	14.8%*	15.5%*	14.6%*	12.8%*	11.1%*
Number of obs.							
Undervalued	267	282	297	302	302	302	290
Overvalued	1372	1650	2067	2155	2155	2153	2024

Note: *, **, *** Means of under- and overvalued SEO firms are different at 1%, 5% and 10% level for a tow-tailed, two-sample t-test assuming unequal variances.

The sample includes all firms that issued seasoned equity between January 1980 and December 1997. SEOs identified as spin-offs by SDC are excluded. Undervalued/overvalued classification is based on the residual income valuation sample. Age is measured as the number of years since a firms listed on a stock market. R&D are research and development expenses. Quick ratio is calculated as (current assets minus inventory) divided by current liabilities. Interest coverage is (interest expense plus income before interest) divided by interest expense. Momentum is 6-month raw return from month −6 till month −1 relative to the month of the issue. All accounting variables are as of the month of the issue (but prior to the day of issue). CAR(t1,t2) is the cumulative abnormal return from day t1 till day t2 relative to the filing date of the SEO. The CARs are calculated using standard market model event study methodology.

undervalued issuers raising new equity capital only when the NPV of a project at hand is sufficiently positive to compensate for costs associated with issuance of undervalued equity. So far, the results are consistent with undervalued firms issuing equity because they are financially stressed.

Consistent with the notion that firms with lower information asymmetry when financially stressed are the results regarding dividends and R&D expense the undervalued issuers pay a significantly higher proportion of their sales in dividends[15] and invest significantly less in R&D. Thus, consistent with Myers and Majluf (1984) the undervalued issuers also appear to be firms with less information asymmetry.

Overall, for undervalued firms, timing the equity issue to periods when they are overvalued or fairly valued might not be an option, since they generate less equity internally and debt financing might be either prohibitively expensive or not available. The undervalued issuers are also firms with lower information asymmetries. The improving operating performance of undervalued firms following the issuance suggests that they issue equity to undertake new projects with an NPV sufficient to compensate for the cost of issuing undervalued equity. The selection bias caused by the worst performing undervalued issuers leaving the sample might be an alternative explanation. However, only 12 undervalued firms leave the sample in year +3. Thus, the selection bias is not a likely explanation of the results.

We conclude that undervalued firms raise equity when they are financially stressed. This is especially the case for issuers with low asymmetric information.

6. Conclusion

This paper examines whether there was a better time to issue seasoned equity when the valuation of a firm's shares might have been even more favorable to the firm. Based on the assumption of asymmetric information about expected earnings, we use three earnings-based models to estimate the intrinsic value of a firm's stock at the time of the SEO. The time series pattern of the estimated misvaluation indicates that SEO firms issue equity when their overvaluation is the greatest. Results from a logistic regression modeling the probability of SEO are consistent with the notion that overvaluation is an important factor in the decision to issue. The evidence supporting the timing hypothesis is robust to a choice of a valuation model, control sample, the effect of long-term growth opportunities, and earnings manipulation.

[15] The ratio of dividends to sales rather than dividends to earnings is used since earnings can be negative.

Furthermore, insiders trade in a manner consistent with the misvaluation level of SEO firms. A small fraction of companies appears to issue stock when their equity is undervalued. Consistent with Myers and Majluf (1984) these firms have lower information asymmetries, are financially constrained, and invest in positive NPV projects.

Overall, the results in this paper indicate that firms are successfully timing their SEOs and take advantage of equity overvaluation. This evidence is consistent with results from an anonymous survey of managers by Graham and Harvey (2000) who find that managers' perceived overvaluation of a firm's stock is one of the most important cited determinants of SEO.

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Appendix A. Valuation Approaches and Implementation

This section provides detailed description of each valuation model. Implementation of all models is described as well. Since managers' expectations of earnings are assumed to equal realized earnings plus zero-mean noise, all valuation three years ahead, while the P/E and dynamic EPS process valuations look one year ahead. All results for the residual income model are replicated using only one year of future earnings. The results (not reported) do not materially affect the conclusions.

A.1. *P/E valuation*

P/E valuation (see, for example, Kaplan and Ruback, 1995; Kim and Ritter, 1999) is implemented using three-digit industry SIC code. If there are fewer

than five firms in a particular three-digit SIC industry grouping, a match on two-digit SIC code is made. The P/E valuation is operationalized in the following way. First, all equity issuing firm-years are deleted from the Compustat data. Then the median market P/E ratio is calculated for each industry. The definition of earnings per share (EPS) is income before extraordinary items available for common stockholders divided by common shares outstanding. The market price is measured as of the fiscal year end. To value the SEO firms, the median industry P/E ratio is multiplied by the realized EPS of the next year. SEO firms with resulting negative fair values are excluded from the sample.

A.2. *Residual income model*

The residual income model (see, for example, Preinreich, 1938; Edwards and Bell, 1961; Peasnell, 1982; Ohlson, 1990) is implemented following D'Mello and Shroff (1999).[16] That is, the following finite horizon estimate is calculated for each firm in the sample:

$$V(0) = B(0) + \frac{\text{EPS}(1) - re^{*}B(0)}{1 + re} + \frac{\text{EPS}(2) - re^{*}B(1)}{(1 + re)^{2}} + \text{TV}, \qquad \text{(A.1)}$$

where the terminal value is calculated as the average of the last two years of data instead of just the last year in order to smooth cases of unusual performance in the last year (D'Mello and Shroff, 1999). That is:

$$\text{TV} = \frac{(\text{EPS}(2) - re^{*}B(1)) + (EPS(3) - re^{*}B(2))}{2} * \frac{1}{(1 + re)^{2*}re}. \qquad \text{(A.2)}$$

$B(t)$ is the book value of equity from the most recent financial statement divided by the number of shares outstanding. The definition of EPS is identical to the one used for P/E valuation. Although defining EPS as income before extraordinary items and discontinued operations violates the clean surplus assumption of the residual income model, it eliminates potentially confounding effects of large one-time items (Dechow *et al.*, 1999a; Barth *et al.*, 1999). re is the cost of equity. Since re is an unknown parameter in the model, an estimate is used in the calculations using Fama and French (1997) CAPM approach: 60 monthly observations prior to the SEO are used to estimate a company's market risk exposure; the beta estimate is then used in

[16] Kaplan and Ruback (1995) employ a capital cash flow valuation model. However, Penman (1998) shows that capital cash flow, dividend, and residual income valuations are equivalent and should yield identical estimates of value when implemented correctly.

conjunction with realized T-bill rate and average market risk premium for a particular month (market risk premium is calculated as the average excess return on the NYSE/AMEX portfolio from January 1945 to month $t-1$). An alternative re_2 measure has been used to determine the robustness of the results. r_2 is the monthly annualized one-month T-bill rate plus the market risk premium relative to the return on the t month's T-bill rate (assuming that all equity betas equal 1). Since results are not materially affected by the choice of the cost of equity estimate, only results based on re_2 are reported. Note that the terminal value (TV) term in Eq. (A.1) is an annuity, assuming no value-relevant growth beyond year three.

Ritter and Warr (2001) show that if investors suffer from inflation illusion, fail to add to income the real depreciation of nominal liabilities that occurs due to inflation, and use nominal discount rates to value real cash flows, a residual income model tends to consistently undervalue stocks. This argument would suggest that the residual income model as implemented in this study would consistently undervalue stocks. However, this concern is mitigated because not the levels of misvaluation but instead (i) the changes in misvaluation and (ii) the relative valuation between various control samples are studied. As long as the methodology of implementing the residual income model does not change from year to year and between SEO and non-SEO firms, the results should be robust to the specification of the nominal versus real discount rates. Additionally, two other valuation models are implemented to examine the robustness of the conclusions to the choice of a valuation model.

When book value of equity is negative in year zero and future earnings are not sufficiently large, or when book value is close to zero and future earnings are sufficiently negative, the residual income model implies negative intrinsic value of a stock. Following Frankel and Lee (1998), firms with negative book values of equity and firms with stock price smaller than \$1.50 are excluded from the sample. When terminal value is negative, it is set equal to zero since managers are unlikely to invest in negative NPV projects indefinitely (Bernard, 1994; Penman and Sougiannis, 1998).

A.3. *Dynamic EPS model*

The third model is based on Bakshi and Chen's (2005). The model, like the residual income model, assumes that a stock entitles its holder to an infinite dividend flow. The firm's dividend policy is assumed to be $D(t) = \delta * \mathrm{EPS}(t) + \varepsilon(t)$, where δ is a target dividend payout ratio, and $\varepsilon(t)$ is a zero-mean error uncorrelated with other stochastic variables in the economy.

A shortcoming of the original Bakshi–Chen model is that it is unable to value firms with negative earnings. To allow for negative earnings, the model defines an adjusted EPS process as $X(t) \equiv \text{EPS}(t) + y_0$. $X(t)$, the adjusted EPS process, and the expected growth rate of $X(t)$, $G(t)$, follow:

$$\frac{dX(t)}{X(t)} = G(t)\,dt + \sigma_x d\omega_x(t), \tag{A.3}$$

$$dG(t) = \kappa_g[\mu_g^0 - G(t)]\,dt + \sigma_g d\omega_g(t), \tag{A.4}$$

where μ_g^0 is the long-run mean of $G(t)$, the conditional expected rate of growth of $X(t)$. κ_g is the speed at which $G(t)$ adjusts to its long-run mean. $\kappa_g, \mu_g^0, \sigma_g$ and σ_x are constants. The instantaneous interest rate in the economy, $R(t)$, follows an Ornstein–Uhlenbeck mean reverting process. Following the standard steps in asset pricing, see Bakshi and Chen (2005), the equilibrium stock price is

$$\begin{aligned} S(t) = \delta \int_0^\infty \{&X(t)\exp[\varphi(\tau) - \gamma(\tau)R(t) + \vartheta(\tau)G(t)] \\ &- y_0 \exp[\phi_0(\tau) - \gamma(\tau)R(t)]\}\,d\tau, \end{aligned} \tag{A.5}$$

where $\varphi(\tau), \gamma(\tau), \vartheta(\tau), \phi_0(\tau)$ are functions of long-run means, volatilities and speeds of adjustment to the long-run means of $G(t)$ and $R(t)$, correlations of $\omega_x(t)$ with $\omega_g(t)$ and $\omega_r(t)$, and the risk premium for the systematic risk in the firm's earnings shocks. So, the equilibrium stock price is a function of the interest rate, current and expected EPS, the firm's required risk premium, and the structural parameters characterizing the EPS and interest rate processes. The implication of firm-specific parameters is that two firms with identical EPS growth can have different stock prices if they differ in the structural parameters of their EPS processes. That is, the price of \$1 dollar of earnings can differ for these two firms. Note that the dividend discount model proposed by Gordon (1962) is a special case of the stock valuation formula in Eq. (A.5). The assumptions leading to this result are constant growth rate of earnings, constant interest rates, and zero correlation between the adjusted earnings process and the pricing kernel.

Strictly speaking, Eq. (A.5) is not a closed form solution to the stock valuation problem. Implementing the model requires a numerical integration of the exponential function. When estimating the model value, the model takes as inputs the current level of interest rates (30 year Treasury bond) and the current and forecasted earnings per share. Two years of data prior to the month of valuation (up to month $t-1$) are used to estimate the model's

structural parameters. Then the model price of the stock is estimated for the subsequent month t. For the current analysis, next year's realized EPS excluding extraordinary items are substituted for forecasted EPS to capture the information asymmetry between managers and the market. To arrive at monthly observations of EPS, EPS are assumed to move toward the next quarter's EPS in a linear fashion. For example, if a firm has 12 months rolling EPS of \$1.00 for a quarter ending in March and \$2.50 for the subsequent quarter ending in July, it is assumed that the monthly 12-month-rolling EPS are \$1.50 and \$2.00 for April and June, respectively.

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