Managers' Private Information, Investor Underreaction and Long-Run SEO Performance

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Abstract

For a sample of 2,879 SEOs by US stocks from 1970 to 2004, this paper decomposes an average three-year post-issue buy-and-hold abnormal return of −25.9% (relative to size- and B/M-matched non-issuing stocks) into two components. One component, representing 41% of the total, is due to lower risk exposure. The second component, representing the remaining 59%, is abnormal performance related to the surprise element of the issue decision, which the paper attributes to managers' private information that the market does not incorporate into the announcement return. This second component results in abnormal returns during the 16 months after the offering.

Keywords: *managerial private information*, *investor underreaction*, *seasoned equity issues*, *long-run performance*

JEL classification: *G*1, *G*2, *G*3

1. Introduction

Seasoned equity issuers underperform benchmark stocks over the long run.[1] We test the behavioural explanation for this finding, namely the underreaction hypothesis, which

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[1] The discussion of Table 1 below cites relevant evidence.

assumes that managers act rationally on their *private information* about stock overvaluation when announcing an equity issue. Investors underreact to the SEO announcement, stock mispricing persists at the issue date, and subsequent underperformance occurs as manager and investor valuations gradually converge. This is consistent with Loughran and Ritter's (1995, p. 48) statement that ' . . . our numbers imply that if the market fully reacted to the information implied by an equity issue announcement, the average announcement effect would be −33 percent, not −3 percent.'

Our proxy for manager's private information about stock overvaluation is the inverse Mills ratio (lambda) from a probit model that predicts the issue decision based on publicly available information. Less anticipated SEO announcements have higher surprise components, implying greater stock overvaluation and giving higher lambdas. The underreaction hypothesis, therefore, states that higher lambdas predict lower post-announcement returns as the announcement effect fails to fully incorporate managers' private information.

For a sample of 2,879 equity issues in the USA over 1970–2004, we decompose an average three-year post-SEO buy-and-hold abnormal return of −25.9%, relative to size and book-to-market (size–B/M) non-issuing stocks, into two components. The first is a −15.43% abnormal return related to the surprise element of the equity issue decision, which we attribute to investor underreaction to managers' private information revealed by the issue announcement. The second component of −10.44% is due to lower post-SEO risk exposure. We show that SEOs are larger, more liquid, with higher investment rates and B/M ratios, and lower gearing and profitability than benchmark stocks after the offering. A detailed analysis of the underreaction to the issue shows that it corrects, on average, within 16 months. Thereafter, SEO returns are consistent with returns on similar assets. This gives a much shorter period of market correction than the five-years in Loughran and Ritter (1995) and Spiess and Affleck-Graves (1995).

The relation between post-issue returns and managers' private information is robust to controlling for pre-issue (abnormal) return performance, SEO attrition before the end of the holding period, delisting returns, and hot issue periods. The results are also robust to possible misspecification of the empirical model that could cause estimates of managerial private information to include public information affecting returns over a cross-section of stocks, since we find no relation between our estimate of managerial private information and returns for size–B/M benchmarks or randomly drawn samples of non-issuing CRSP stocks.

This study decomposes SEO post-issue performance relative to size–B/M benchmarks into a short-term underreaction effect and a long-run discount rate effect. We propose an unbiased and consistent test of the underreaction story compared to previous studies that investigate whether investors rationally interpret *publicly* available information around the equity offering. A relation between public information and post-issue returns could reflect a relation that affects all stocks, rather than an effect specific to the equity issue.[2] Consequently, past studies offer weak support for the underreaction hypothesis. Our tests control for the discount rate hypothesis, which says that lower risk explains low

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[2] For example, Rangan (1998) attributes low SEO post-issue returns to investor underreaction to pre-issue earnings management. Xie (2001), however, finds that investors overprice discretionary accruals in a cross-section of stocks and high discretionary accruals predict low returns over the following two years. Xie (2001, p. 359) argues that '[discretionary accruals] mispricing is not limited to settings that give managers opportunistic incentives to manipulate earnings, such as before IPOs or seasoned equity offerings'.

SEO returns. We show that SEO post-issue expected return estimates are biased and inconsistent in the absence of a formal model of managers' private information and their decision to make an SEO. In contrast to some previous findings, however, we find that a discount rate effect alone cannot explain SEO underperformance.

Evidence of less-than-rational investor behaviour around various corporate events suggests that adjusting for private information should accompany any cross-sectional regression of post-announcement returns.[3] Our study has implications for related international research, since the literature documents SEO underperformance in non-US markets with different regulatory and institutional regimes and other equity flotation methods.

The paper proceeds as follows. The following section reviews previous literature that examines the underreaction and discount rate explanations for post-SEO returns and presents our empirical hypothesis. Section 3 develops an econometric model to test this hypothesis. Section 4 presents the data and we confirm previous evidence of SEO underperformance in Section 5. We test our hypothesis and present empirical results in Section 6. Section 7 examines the length of the delayed market reaction and Section 8 concludes.

2. Previous Literature and Development of the Underreaction Hypothesis

Several studies document abnormally low SEO returns up to five-years after equity issues. Table 1 summarises US and international evidence on long-run SEO performance using buy-and-hold abnormal returns. Underperformance ranges from −9.0% over three years for German SEOs from 1960–1992 (Stehle *et al.*, 2000) to −53.3% over three years for Canadian SEOs from 1993–2004 (Carpentier *et al.,* 2010) and to −59.4% over five years for US SEOs from 1970–1990 (Loughran and Ritter, 1995).

Direct evidence on whether SEO underperformance is due to irrational investor behaviour around equity offerings is difficult to obtain. Previous studies investigate whether investors rationally interpret manager and analyst actions around equity offerings. Rangan (1998), Teoh *et al*. (1998), and DuCharme *et al*. (2004) show that increases in pre-issue discretionary accruals predict post-issue returns, consistent with investors incorrectly extrapolating pre-issue earnings performance.[4] Shivakumar (2000), however, finds that the market rationally anticipates pre-issue earnings management and undoes its effect at the issue announcement. He argues that test misspecification explains Rangan's (1998) and Teoh *et al*.'s (1998) results. Jegadeesh (2000) suggests that investors are over-optimistic about issuers' future earnings at the issue date and adjust their expectations in response to disappointing earnings results after the issue. Jegadeesh reports that SEOs underperform by twice as much around post-issue quarterly earnings announcements as outside these periods. Brous *et al*. (2001), however, find no evidence of abnormal returns around quarterly post-issue earnings announcements. As most of these studies assume investor underreaction to publicly available information, failing to model investor reaction to managerial private information may explain their different results.

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[3] See Subrahmanyam (2007) for a recent review of the behavioural finance literature.

[4] Iqbal *et al*. (2009) provide corresponding evidence on earnings management before UK open offers.

Table 1

Previous evidence on the long-run performance of seasoned equity issuers

This table reports mean buy-and-hold abnormal returns from previous studies on the long-run performance following seasoned equity issues.

Country	Study	Sample size	Holding period	Sample period	Mean buy-and-hold abnormal return (%)
Australia	Brown *et al.* (2010)	1828	3 years	1992–2006	−14.4%
Canada	Carpentier *et al.* (2010)	958	3 years	1993–2003	−53.3%
France	Jeanneret (2005)	232	3 years	1984–1998	−18.2%
Germany	Stehle *et al.* (2000)	584	3 years	1960–1992	−9.0%
Japan	Cai and Loughran (1998)	1389	5 years	1971–1992	−29.1%
Spain	Pastor-Llorca and Martin-Ugedo (2004)	44	3 years	1989–1996	−13.7%
UK	Levis (1995)	203	1.5 years	1980–1988	−18.5%
US	Loughran and Ritter (1995)	3702	5 years	1970–1990	−59.4%
	Spiess and Affleck-Graves (1995)	1247	5 years	1975–1989	−42.4%
	Mitchell and Stafford (2000)	4439	3 years	1961–1993	−10.2%
	Eckbo *et al.* (2000)	3315	5 years	1964–1995	−23.2%
	Brav *et al.* (2000)	3775	5 years	1975–1992	−26.3%
	Jegadeesh (2000)	2992	5 years	1970–1993	−34.3%
	Ritter (2003)[a]	7760	5 years	1970–2000	−16.67%
	Billett *et al.* (2011)[b]	2942	3 years	1983–2005	−9.6%

[a] For Ritter (2003), five-year buy-and-hold abnormal returns are based on average annual returns in the five years after the issue for size-matched control firms.
[b] For Billett *et al.* (2011), buy-and-hold abnormal returns are based on mean monthly abnormal returns from Fama–MacBeth regressions.

Information asymmetry between managers and investors allows managers to determine when the firm's stock is overpriced and use this information in their equity issue decisions. Investors form expectations of the likelihood and information content of equity issues using market and firm-specific information available before the offering. For example, investors can use accounting information, news reports, and stock price movements to assess the degree of firm misvaluation and the likelihood of managers making an equity offering. Stock prices should impound this information before the issue announcement. Bayesian investors should update their assessment of firm value based on managers' private information revealed by the announcement and stock prices should react fully and unbiasedly, so that SEOs earn normal post-issue returns. But if investors only partially discount the information in the issue announcement, post-issue SEO abnormal returns will be negative, as stock prices gradually adjust.

Figure 1 illustrates the relation between investor behaviour, managers' private information, and SEO stock price. Figure 1a shows the evolution of SEO stock price around the announcement if investors are rational. Investors predict an equity issue and impound the anticipated issue effect into the stock price before the announcement.[5]

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[5] For simplicity, Figure 1 ignores SEO price run-up before the issue announcement.
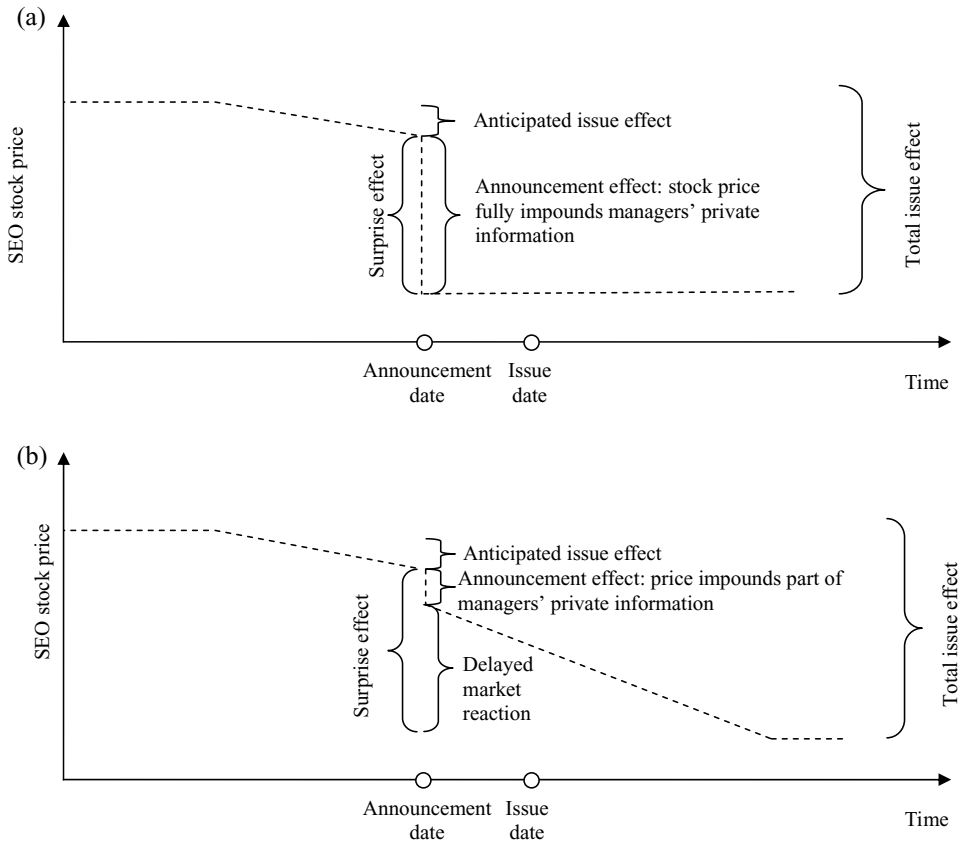
Fig. 1. The relation between managers' private information revealed at the issue
announcement and SEO stock price

This figure depicts the relation between managers' private information revealed at the SEO announcement date and SEO stock price before and after the issue announcement for alternative types of investor behavior. Fig.1a shows the relation assuming investors act rationally and discount new information into stock price with no delay. Fig. 1b shows the relation when investors delay impounding managers' private information revealed at the issue announcement into the stock price.

On announcement, investors fully discount managers' private information and there is no long-run abnormal SEO performance. Figure 1b shows the SEO price path when investors partially discount managers' private information at the announcement date. Stock price fully impounds the signal over a post-issue period, leading to SEO underperformance, consistent with the underreaction hypothesis.[6] Once the stock price fully impounds the signal, SEO returns reflect post-issue risk. Figure 1 shows that testing the underreaction hypothesis is equivalent to testing for a significant negative relation between managers' private information and post-issue SEO buy-and-hold returns.

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[6] Although the SEO announcement reveals managers' private information, empirical studies measure long-run SEO abnormal performance relative to the issue date. We follow this convention for comparability with previous studies.

The underreaction hypothesis: lower post-issue SEO stock returns are associated with greater managerial private information revealed by the SEO announcement.

The underreaction hypothesis contrasts with the discount rate hypothesis, which says that reduced risk exposure explains low SEO returns. Eckbo *et al*. (2000) argue that SEO firms have lower leverage than size–B/M benchmarks, which reduces their risk exposure to unexpected inflation, the default spread, and changes in the slope of the term structure. Eckbo and Norli (2005) show that a liquidity-augmented Carhart (1997) model explains SEO five-year post-issue returns in calendar time. Lyandres *et al*. (2008) argue that firms raise equity to convert risky growth options into fixed assets, which lowers risk. They document that three-year post-issue returns load negatively on an investment factor, which explains their post-issue performance.

The evidence that reduced risk explains low SEO returns comes from calendar time analysis, which may have lower power to detect abnormal returns than event time analysis. Simulating events with more severe misvaluations in small stocks and high-volume periods, Loughran and Ritter (2000) report that Fama–French three-factor calendar time regressions capture only 50% of true abnormal returns, compared with 80% for event time buy-and-hold abnormal returns relative to size–B/M benchmarks. Ang and Zhang (2004) find in simulations that the power of Fama–French three-factor calendar time regressions 'decreases sharply as event horizon increases' (p. 255).

3. A Model of Long-run SEO Abnormal Returns when Mispricing Causes the Rvent

This section develops a model of long-run SEO abnormal returns when managers time issues of mispriced equity, investors underreact to the information revealed by the issue announcement, and the stock price fully impounds the information over a post-issue period. We start by describing the traditional estimator of abnormal returns when the source of abnormal performance is unknown. We call this the unconditional estimator of SEO abnormal return. To capture investor underreaction to managers' private information and prices impounding the information over a post-issue period, we then propose a conditional abnormal return estimator.

3.1 *The unconditional estimator of SEO abnormal returns*

A typical event study compares the return performance of an event firm to a counterfactual benchmark. To model this formally, consider issuing firm i's post-event return, R_{1i}, in excess of the risk free rate, R_f, as a function of systematic risk, X_i, a firm specific component, u_{1i}, and an event induced stock price reaction, d_1, where subscript 1 indicates the act of issuing. Similarly, the counterfactual return for SEO firm i, R_{0i}, in excess of the risk free rate, R_f, is a function of risk, X_i, a firm specific component, u_{0i}, and a non-event related performance, d_0, where subscript 0 indicates the act of not issuing. The counterfactual state is the hypothetical state in which an equity issuer chooses not to issue, and the event window that defines R_{1i} and R_{0i} usually spans three to five years. Two outcome equations give the post-event expected returns

$$E(R_{1i} - R_f | X_i) = d_1 + X_i \beta_1 + E(u_{1i}) \text{ for firm } i \text{ in the act of issuing} \qquad (1)$$

$$E(R_{0i} - R_f | X_i) = d_0 + X_i \beta_0 + E(u_{0i}) \text{ for firm } i \text{ in the act of not issuing} \qquad (2)$$

The *unconditional issue effect* is the difference between equations (1) and (2), where 'unconditional' denotes that returns are not conditioned on managers' issue decision. In the general case where the equity offering changes the issuer's risk, this is

$$E(R_{1i}|X_i) - E(R_{0i}|X_i) = d_1 - d_0 + X_i(\beta_1 - \beta_0) \qquad (3)$$

where a negative $d_1 - d_0$ corresponds to SEO underperformance. While equation (3) is the commonly estimated (pooled) cross-sectional regression, it fails to model the source of abnormal performance, $d_1 - d_0$.

3.2 *A conditional estimator of SEO returns*

To generate unbiased and consistent estimates of SEO post-issue risk exposure and test the underreaction hypothesis, we model managers' issue decision. Managers issue equity based on their assessment of the offering's expected benefits, D_i^*. The equity issue selection equation models D_i^* as a function of observable and unobservable components, $Z_i\gamma$ and u_{di},

$$D_i^* = Z_i\gamma + u_{di} \qquad (4)$$

The component $Z_i\gamma$ captures the issue benefits that both managers and investors observe. For example, managers and investors can use market and accounting measures to assess the value of positive NPV projects available to the firm, the average return on investment expected from exercising growth options, and the equity dilution cost to old shareholders of issuing new shares. The component u_{di} captures the issue benefits observed by managers alone, i.e. *managers' private information*. In line with the underreaction hypothesis, u_{di} captures the benefit of issuing overvalued equity.

Firms announce an equity issue, $D_i = 1$, only if the expected issue benefits are positive, $D_i^* \geq 0$, where the normalised threshold is zero. Investors observe the issue decision and the component $Z_i\gamma$. They do not observe u_{di} but can infer it from the issue decision. For example, they can infer from a firm's decision to issue that u_{di} must be high if $Z_i\gamma$ is too low to justify the offering. Similarly for non-issuers, high anticipated issue benefits, $Z_i\gamma$, are likely to be associated with low u_{di} for the expected issue benefits to remain negative.

We observe returns in the issue (non-issue) state if the expected benefits are positive (negative), $D_i = 1$ *iff* $D_i^* \geq 0$ ($D_i = 0$ *iff* $D_i^* < 0$), which implies that SEO post-issue returns are conditional on D_i^*. Accordingly, the conditional expected SEO excess returns are

$$E(R_{1i} - R_f|X_i, D_i^* \geq 0) = X_i\beta_1' + E(u_{1i}|u_{di} + Z_i\gamma \geq 0) \qquad (5)$$

$$E(R_{0i} - R_f|X_i, D_i^* < 0) = X_i\beta_0' + E(u_{0i}|u_{di} + Z_i\gamma < 0) \qquad (6)$$

for firm i in the acts of issuing and not issuing.[7] In simple terms, expected SEO post-issue performance depends on risk and a conditional error term. If the

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[7] When u_{1i} and u_{0i} are correlated with u_{di}, i.e., when investors underreact to managers' private information revealed by the issue and $corr(u_{di}, X_i) \neq 0$, equations (5) and (6) give unbiased and consistent estimators of β'. This follows from directly modelling manager's endogenous decision to issue and including its effect in the regression specification based on equations (5) and (6), which corrects for the omitted variables bias.

underreaction hypothesis holds, post-issue abnormal performance is due to prices gradually incorporating managers' private information, u_{di}, i.e., $E(u_{1i}|u_{di} + Z_i\gamma \geq 0) \neq 0$ and $E(u_{0i}|u_{di} + Z_i\gamma < 0) \neq 0$.

3.3 *Estimating the return effect of managers' private information*

To estimate equations (5) and (6), we assume bivariate normal distributions for u_{1i}, u_{di} and u_{0i}, u_{di} with covariances $\sigma_{u_d u_1}$ and $\sigma_{u_d u_0}$, which transforms equations (5) and (6) to

$$E(R_{1i} - R_f \mid X_i, D_i^* \geq 0) = X_i\beta_1' + E(u_{1i} \mid u_{di} \geq -Z_i\gamma)$$

$$= X_i\beta_1' + \sigma_{u_d u_1} \frac{\phi\left(-Z_i\gamma/\sigma_{u_d}\right)}{1 - \Phi\left(-Z_i\gamma/\sigma_{u_d}\right)}$$

$$= X_i\beta_1' + \sigma_{u_d u_1} \frac{\phi\left(Z_i\gamma/\sigma_{u_d}\right)}{\Phi\left(Z_i\gamma/\sigma_{u_d}\right)} = X_i\beta_1' + \sigma_{u_d u_1}\lambda_{1i} \quad (7)$$

$$E(R_{0i} - R_f \mid X_i, D_i^* < 0) = X_i\beta_0' + E(u_{0i} \mid u_{di} < -Z_i\gamma)$$

$$= X_i\beta_0' + \sigma_{u_d u_0} \frac{-\phi(Z_i\gamma/\sigma_{u_d})}{1 - \Phi(Z_i\gamma/\sigma_{u_d})}$$

$$= X_i\beta_0' + \sigma_{u_d u_0}\lambda_{0i}$$

$$(8)$$

where $\phi(.)$ and $\Phi(.)$ are the standard normal pdf and cdf and λ_{1i} and λ_{0i} are inverse Mills ratios. Equations (7) and (8) are standard representations of Heckman's (1979) sample selection adjustment, but we show that the inverse Mills ratios also measure the announcement date information revealed by managers.

In equations (7) and (8), $\sigma_{u_d u_1}\lambda_{1i}$ and $\sigma_{u_d u_0}\lambda_{0i}$ capture the effect of information revealed by the issue announcement and non-announcement on subsequent performance.[8] The size of the stock price adjustment after the issue depends on the amount of private information u_{di} (since low $Z_i\gamma$ means high u_{di} to reach the issue threshold, which in turn leads to high λ_{1i}),[9] on the strength of the correlation between the error terms in the selection equation (4) and outcome equations (1) and (2) ($\sigma_{u_d u_1} = \rho_1\sigma_{u_d}\sigma_{u_{1i}}$ and $\sigma_{u_d u_0} = \rho_0\sigma_{u_d}\sigma_{u_{0i}}$ for the issue and non-issue states), and on the variances of u_{di}, u_{1i}, and u_{0i}. Intuitively, the correlation coefficients ρ_1 and ρ_0 measure the proportion of the announcement date information that stock prices impound after the issue. Perfect correlation means post-issue returns reflect all the announcement date information and zero correlation means stock prices fully impound managerial information at the offering announcement. With high variation in the magnitude of private information, σ_{u_d}, a larger u_{di} is more likely. Larger u_{di} means larger benefits of issuing overvalued equity, consistent with greater misvaluation. High return volatility, $\sigma_{u_{1i}}$ and $\sigma_{u_{0i}}$, is commonly associated with high firm value uncertainty and potentially larger stock mispricing.

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[8] Scaling $-Z_i\gamma$ by the cross-sectional standard deviation of manager's private information, σ_{u_d}, ensures comparability of u_{di} across firms and normalises its variance to one.

[9] For a given $Z_i\gamma$, if a firm issues, investors can infer that u_{di} is larger than in the non-issue state to reach the threshold $Z_i\gamma + u_{di} \geq 0$. As $Z_i\gamma$ falls, u_{di} needs to be higher to reach the threshold, leading to a larger λ_{1i}.

Subtracting equation (8) from equation (7) gives the *conditional issue effect*

$$E(R_{1i}|X_i, D_i^* \geq 0) - E(R_{0i}|X_i, D_i^* < 0) = \sigma_{u_d u_1}\lambda_{1i} - \sigma_{u_d u_0}\lambda_{0i} + X_i(\beta_1' - \beta_0') \quad (9)$$

where $\sigma_{u_d u_1}\lambda_{1i} - \sigma_{u_d u_0}\lambda_{0i}$ is the post-event stock price adjustment in the issue vs. non-issue states as the market impounds the information u_{di}, and $X_i(\beta_1' - \beta_0')$ is the differential risk exposure. Unlike equation (3), equation (9) distinguishes the behavioural explanation for low SEO returns (investor underreaction) from the rational (risk-based) explanation, allowing a test of the underreaction hypothesis. The hypothesis predicts a negative relation between post-issue returns and the surprise component of the issue announcement, λ_{1i}, reflecting managers' information about stock mispricing. If the underreaction hypothesis is true, $\sigma_{u_d u_1}$ should be negative for equity issuers. Intuitively, a highly unexpected issue conveys more information and post-issue abnormal performance should be lower. Equation (9) also provides an unbiased and consistent test of the discount rate effect. If issuing lowers risk, a discount rate effect corresponds to $X_i(\beta_1' - \beta_0') < 0$.

To control for SEO returns in the non-issue state, following Spiess and Affleck-Graves (1995) and other studies, we use size–B/M matched control firms.[10] As benchmark stocks do not announce a non-issue decision and issue decisions are largely unexpected, we predict an insignificant relation between $\sigma_{u_d u_0}$ and benchmark stock returns.

Loughran and Ritter (1995) and Spiess and Affleck-Graves (1995) find that it takes up to five years for the initial underreaction to SEO announcements to disappear. This is at odds with empirical evidence that suggests irrational investor behaviour is more short-lived. For example, Michaely *et al.* (1995) find that stocks announcing dividend initiations or omissions exhibit abnormal stock performance over the following twelve months. Womack (1996) finds that the initial underreaction to unfavorable changes in analyst recommendations corrects within six months. Bernard and Thomas (1989) report that the initial underreaction to earnings announcements corrects within three quarters. A more likely scenario for SEOs, therefore, is that stock prices fully impound managers' private information well within five years and a discount rate effect dominates over the remaining holding period. To estimate how rapidly prices impound the issue signal, we vary the return holding period. Once stock prices fully impound the signal, we should find no relation between lambda and issuer returns.

While the underreaction hypothesis predicts that investors underreact to private information about stock mispricing revealed by the issue, investors could also underreact to public information on firm mispricing. For example, investors may only partially discount the information contained in abnormal stock return performance before the announcement. Including this information in the regression controls for any delayed reaction to public information.

3.4 *Empirical specification issues*

The empirical validity of model (9) hinges on accurately identifying the systematic component of the equity issue decision in equation (4), $Z_i\gamma$. If the equity issue decision

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[10] Baker and Wurgler (2000) argue that managers can time not only individual stock mispricing, but also market-wide mispricing. Size–B/M matching over the post-issue period also controls for market-wide mispricing.

model excludes publicly available information, it becomes part of the error term and lambda. To check whether lambda captures public information omitted from $Z_i\gamma$, we conduct two tests. First, we test whether lambda predicts the returns of size–B/M benchmark stocks. Second, we relate lambda to returns of random samples of non-issuing stocks. An insignificant relation between lambda and benchmark or non-issuer stock returns suggests that there is no significant public information component in lambda and no misspecification of the empirical model in equation (4).

4. Data and Sample Selection Criteria

Our sample of seasoned equity offerings is from the SDC New Issues database. The sample period is January 1970 to December 2007. To allow for a three-year holding period, the last offering is in December 2004. The sample includes all CRSP US domiciled companies listed on NYSE/AMEX/Nasdaq at the time of the SEO that issue pure primary shares or combinations of primary and equity sales by a major shareholder (combinations) in the US market. We include industrial, financial, and utility firms but exclude unit offerings and SEOs that simultaneously offer debt, preferred stock, or warrants. We exclude private placements, exchange offers of stock, 144A offers, cancelled offers, and spin-off related issues. We also exclude SEOs within three years of an IPO to prevent IPO underperformance influencing the results. These criteria lead to an initial sample of 8,223 issues. Excluding equity offerings by the same company that occur within the three-year holding period of the first equity offering, reduces the sample to 5,121. Retaining offerings of common stock only (CRSP share codes 10 and 11) with stock return data available for at least a month after the issue leaves 4,931 issues.[11] Obtaining a conditional estimator of abnormal returns requires non-missing CRSP/Compustat annual data for two fiscal years before the issue. We use accounting data for the fiscal year ending at least six months before the issue date, leaving 3,047 SEOs.[12] Following Loughran and Ritter (1995) and Spiess and Affleck-Graves (1995), we use only issuers and benchmark stocks with positive equity book values in the matching process, which reduces the sample to 2,879 SEOs for which we find control stocks. NYSE/AMEX and Nasdaq listed stocks on CRSP that have not issued new equity for the past three years provide a pool of potential matching stocks.

Table 2 reports the distribution of the SEOs across NYSE/AMEX and Nasdaq exchanges, broad industry groups (financial, industry, and utility), nine Fama and French size and B/M portfolios, and issue period. Of the 2,879 SEOs, 46.58% list on NYSE/AMEX and 53.42% on Nasdaq. Industrial issuers are the largest group, with 2,498 SEOs. Splitting issuers into three portfolios, small (*S*), medium (*Me*), and big (*B*) by market value of common equity using NYSE breakpoints, 1,489 are small capitalisation firms. A corresponding split on B/M into high (*H*), medium (*M*), and low (*L*) gives 1,148 low B/M stocks, of which 534 are small. Previous studies document that small, low B/M stocks, which are subject to larger valuation errors and more susceptible to misvaluation, dominate equity issuers (e.g., Brav *et al.,* 2000, Table 2). The number of

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[11] Using CRSP share codes 10 and 11 excludes closed-end funds and REITs.

[12] To match an SEO with a non-issuing control firm, we use book value of equity for the fiscal year two years before the issue if the offering is in the first six months of the year and book value for the previous fiscal year for offers in the second six months of the year.

Table 2

Distribution of SEOs over the sample period 1970—2004

This table shows the distribution of 2,879 SEOs across NYSE/AMEX and Nasdaq stocks, three industry groups (Financial, Industrial and Utility), Fama and French size (Small, *S*, Medium, *Me*, Big, *B*) and B/M (High, *H*, Medium, *M*, Low, *L*) portfolios, issue period (1970–1979, 1980–1989, 1990–1999, 2000–2004), and as a percentage of the full sample. The sample includes US domiciled companies from CRSP, listed on NYSE/AMEX/Nasdaq at the time of the issue, that make offerings of pure primary shares or combinations of primary and equity sales by a major shareholder (combinations) in the US market. We include industrial, financial, and utility firms but exclude unit offerings and SEOs that simultaneously offer debt, preferred stock, or warrants. The sample excludes private placements, exchange offers of stock, 144A offers, cancelled offers, spin-off related issues, SEOs within a three-year period of an IPO, and equity offerings by the same company that occur within the three-year holding period of a prior equity offering. We retain offerings of common stock only (CRSP share codes 10 and 11) with stock return data available for at least a month after the issue and with non-missing CRSP/Compustat annual data for the conditional estimator of SEO abnormal returns for two fiscal years before the issue. We use only issuers and benchmark stocks with positive equity book values in the matching process.

	SEOs	% of the full sample
Total	2879	
NYSE/AMEX	1341	46.58
Nasdaq	1538	53.42
Financial	127	4.41
Industrial	2498	86.77
Utility	254	8.82
FF *S–L*	534	18.55
FF *S–M*	511	17.75
FF *S–H*	444	15.42
FF *Me–L*	401	13.93
FF *Me–M*	304	10.56
FF *Me–H*	173	6.01
FF *B–L*	213	7.40
FF *B–M*	186	6.46
FF *B–H*	113	3.92
1970–1979	169	5.87
1980–1989	578	20.08
1990–1999	1048	36.40
2000–2004	1084	37.65

issuers increases over time, with 169 SEOs occurring in the 1970s and 1,084 between 2000 and 2004.[13]

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[13] The lower number of SEOs in the early sample period is partly due to Nasdaq data being unavailable on CRSP before December 1972 and less complete Compustat coverage in the 1970s.

5. The Long-run Performance of SEOs: Unconditional Estimates of the Issue Effect

Barber and Lyon (1997) show that tests using buy-and-hold abnormal returns and size–B/M matches are well specified, and studies of SEO underperformance largely follow this design.[14] We replicate matching based on the closest neighbour approach. Of non-issuing firms within a 30% range of the issuer's market value at the year-end before the offering, we select a matching firm with the closest B/M to the issuer's. Non-issuers are companies that are not listed as equity issuers on the SDC New Issues database for the past three years. The definition of B/M follows Fama and French (1992). Each control stock pairs with one SEO over the three-year holding period. If a control stock delists or issues equity, we choose a new match from the original list of eligible controls. If an issuing firm delists, we truncate the SEO and its match return on that date.

Sample firm i's t_i-month buy-and-hold return (BHR) is $BHR_i = \prod_{\tau=1}^{t_i}(1 + R_{i\tau}) - 1$, starting at the beginning of the first calendar month after the issue and finishing at the earlier of the three-year anniversary or the delisting date. The average holding period return across N sample stocks is $\overline{BHR} = \sum_{i=1}^{N} x_i BHR_i$ where x_i denotes equally weighted (EW) or value-weighted (VW). Value weights are market capitalisations scaled by the S&P 500 stock market index one month before the offer to ensure that early and late sample observations have consistent weights.

Table 3 reports average BHRs for issuers and their matches over a three-year holding period. Column *Diff*, denoting the difference between these two figures, gives issuers' buy-and-hold abnormal return (BHAR). Panel A shows EW and VW results. The average BHAR using EW is −25.87% and −22.6% using VW. Underperformance is significant in all specifications at 1% based on skewness-adjusted *t*-statistics recommended by Lyon *et al.* (1999).

We previously argued that abnormal performance following equity issues should be relatively short-lived, as investors correct their valuations and stock prices impound the announcement date signal. We test this prediction in Table 3, Panel B where we increase the return holding period one month at a time. BHARs are −11.33% for a one-year holding period, −21.34% for a two-year holding period, and −25.87% for a three-year holding period. The geometric average abnormal monthly return over the first sixteen months following the issue is −1.054%, while it is −0.834% over the next ten months, and −0.459% over the last ten months of the three-year holding period.[15] This suggests SEO underperformance concentrates shortly after the offering.[16]

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[14] Calendar time regressions using Fama and French's (1993) model also record SEO underperformance (Loughran and Ritter, 1995, 2000, Lyandres *et al.*, 2008, Eckbo *et al.*, 2000).

[15] Loughran and Ritter (1995) document strong SEO underperformance relative to size-matched control firms over months 7–18 after the issue. They report less negative issuer abnormal performance over months 19–60.

[16] Ritter (2003, Table 1) finds that a sample of 6,638 SEOs over 1970–2000 have average buy-and-hold abnormal returns of 2% compared to size–B/M control firms in the six months after the issue. Relative to Ritter's sample, we exclude SEOs within 36 months of an IPO, multiple issues, and SEOs without necessary Compustat data. Over 1970–1990, these additional data requirements increase average SEO market capitalisation by 19.62% and lower issuer performance to an (insignificant) −2.38%. Lifting the restrictions gives an insignificant six-month BHAR of 1.98%.

Table 3

Unconditional stock performance following seasoned equity offerings

Panel A reports equally-weighted (EW) and value-weighted (VW) buy-and-hold returns (in %) for 2,879 equity issuers (*Issuer*), size–B/M matched control firms (*Match*), and their difference (*Diff*) over a three-year post-issue period starting at the beginning of the first calendar month after the issue and finishing at the earlier of the three-year anniversary or the delisting date. *p* is the *p*-value based on a skewness-adjusted *t*-statistic testing the hypothesis of no difference between average long-run performance of issuers and their matches. In calculating value weights we standardise market capitalisation by the S&P 500 stock market index to ensure comparability over time. Panel B reports EW SEO and benchmark performance where we increase the holding period from 1 to 36 months after the issue.

Weight/Holding period	*Issuer* (%)	*Match* (%)	*Diff* (%)	*p*
Panel A: Unconditional SEO performance for three years after the issue				
EW	14.94	40.81	−25.87	0.000
VW	21.37	43.98	−22.60	0.000
Panel B: EW long-run SEO performance as the holding period increases				
0–1	0.70	0.59	0.10	0.776
0–2	−0.13	0.99	−1.12	0.022
0–3	−0.14	1.84	−1.98	0.001
0–4	−1.06	2.31	−3.36	0.000
0–5	−1.64	3.26	−4.91	0.000
0–6	−1.12	4.37	−5.50	0.000
0–7	−1.09	5.47	−6.56	0.000
0–8	−0.92	6.46	−7.38	0.000
0–9	−0.91	7.42	−8.33	0.000
0–10	−1.40	8.20	−9.60	0.000
0–11	−1.55	9.19	−10.74	0.000
0–12	−1.40	9.93	−11.33	0.000
0–13	−1.57	11.49	−13.06	0.000
0–14	−0.99	13.46	−14.45	0.000
0–15	−0.86	14.51	−15.38	0.000
0–16	−0.44	15.16	−15.60	0.000
0–17	−0.10	16.50	−16.60	0.000
0–18	0.84	17.46	−16.62	0.000
0–19	1.76	18.69	−16.92	0.000
0–20	1.60	19.80	−18.21	0.000
0–21	2.68	21.37	−18.69	0.000
0–22	3.21	22.27	−19.06	0.000
0–23	3.72	23.50	−19.78	0.000
0–24	3.80	25.14	−21.34	0.000
0–25	4.39	26.38	−21.99	0.000
0–26	5.16	27.54	−22.38	0.000
0–27	5.80	29.40	−23.61	0.000
0–28	7.06	29.96	−22.90	0.000
0–29	8.16	30.81	−22.65	0.000
0–30	9.63	32.57	−22.94	0.000
0–31	10.44	33.92	−23.48	0.000
0–32	10.77	35.43	−24.67	0.000
0–33	11.56	36.71	−25.16	0.000
0–34	12.64	38.26	−25.62	0.000
0–35	13.99	39.28	−25.29	0.000
0–36	14.94	40.81	−25.87	0.000

The unconditional estimator of abnormal returns in equation (3) highlights the differential risk exposure of SEOs and benchmark stocks as a potential explanation of issuer underperformance. Previous studies suggest that post-offering SEO performance relates to a number of risk factors and market characteristics. These include the issuer's equity market value and B/M ratio, leverage (Eckbo *et al.*, 2000), stock liquidity (Eckbo and Norli, 2005), and investment rates (Lyandres *et al.*, 2008). In addition to these characteristics, we control for firm profitability measured by return on assets. Chen *et al.* (2010), building on the *q*-theory of investment (Tobin, 1969; Cochrane, 1991), link discount rates to firm investment and profitability. This is because, given a firm's profitability, a low discount rate means high net present values of new projects, which stimulates new investment. They propose a three factor model in which market, investment, and profitability factors explain a wide cross-section of stock returns and several anomalies that the Fama and French (1993) and Carhart (1997) models fail to capture. Finally, the timing hypothesis predicts equity issues follow abnormal stock price performance. We use the market-adjusted stock return over the six pre-issue months to proxy for a firm's pre-issue misvaluation.[17]

Table 4, Panel A verifies the above predictions by reporting results of a regression with three-year BHRs of SEOs or their matches as the dependent variable. The independent variables include, in log form, book-to-market ratio (*B/M*), equity market value (*MV*), leverage (*LEV*), and illiquidity level (*LM*12).[18] *LEV* is the ratio of total liabilities to total assets. *LM*12 is Liu's (2006) trading discontinuity measure of liquidity, which builds on the intuition that a large number of no trading days indicates trading discontinuity and the potential difficulty in executing an order, and the turnover adjustment captures the ability to trade large quantities of stock.[19] Liu (2010) shows that *LM*12 captures multiple liquidity dimensions and that it generates a more robust liquidity premium than the bid-ask spread, Hasbrouck's (2009) Gibbs estimate of stock transactions costs, Lesmond *et al.*'s (1999) number of zero daily returns, stock turnover, and Amihud's (2002) return-to-volume measure. The independent variables also include the investment-to-assets ratio (*INV/A*), return on assets (*ROA*), and pre-issue abnormal performance (*pAB*). *INV/A* is the change in property plant and equipment plus the annual change in inventories scaled by lagged asset value. *ROA* is income before extraordinary items over lagged asset value. *pAB* is the difference between the firm's and the CRSP VW NYSE/AMEX/Nasdaq index buy-and-hold returns over the six months before the issue. *B/M*, *LEV*, *ROA* and *INV/A* are measured in December at

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[17] Descriptive statistics for these variables and the variables related to the equity issue decision are in Table 5.

[18] Market values in all regressions are deflated by the S&P 500 market index to give comparability over time.

[19] Liu (2006, p.635) defines *LM*12 as the standardised turnover-adjusted number of zero-trading volume days over the prior 12 months, (number of zero volume days in prior 12 months + (1/(*TR12* × *Deflator*))) × ((21 × 12)/*NoTD*), where *TR*12 is the sum of daily turnover (in percentage) over the prior 12 months, *Deflator* = 20,000 to ensure that 1/*TR*12 × *Deflator* < 1, and *NoTD* is the number of trading days over the prior 12 months; (21 × 12)/*NoTD* standardises the number of trading days in a month to 21. Sorting stocks on *LM*12 is equivalent to a first sort on the number of zero daily trading volumes with a turnover sort resolving any ties, where the latter applies primarily to frequently traded stocks with zero non-trading days.

Table 4

Regressions of buy-and-hold returns on pre-event firm and market characteristics

Panel A reports regression estimates (*Estimate*) for equations (1) and (2) where the dependent variable is the three-year buy-and-hold return of SEOs or their matches. The explanatory variables are book-to-market (*B/M*), total market capitalisation in \$m deflated by the S&P 500 market index (*MV*), Liu's (2006) liquidity measure (*LM*12), and leverage (*LEV*), all in log form, investment-to-assets (*INV/A*), return on assets (*ROA*) and pre-issue abnormal return performance (*pAB*). *MV, LM*12 and *pAB* are measured one month before the issue. *B/M, LEV, ROA* and *INV/A* are for the prior fiscal year-end at least six months before the issue and, together with *LM*12, are winsorised based on the CRSP population at ±1%. *SE* denotes year- and industry-clustered standard errors and *p* the *p*-value. *N* is the number of observations, *F* and *P > F* are the *F*- and corresponding *p*-values for model specification and *Adj R²* is the adjusted R-square. Panel B shows the difference in coefficients between SEOs and control stocks (*Beta diff*) and mean firm characteristics for SEOs (*X SEO*), matches (*X matches*) and their difference (*X diff*). Average firm characteristics are over a 3-year post-issue holding period. *SE* denotes year- and industry-clustered standard errors and *p* is a *p*-value for the significance of the differences.

Panel A: Regression estimates for equations (1) and (2)

	SEOs			Matches		
	Estimate	*SE*	*p*	*Estimate*	*SE*	*p*
Intercept	0.436	0.065	0.000	0.618	0.051	0.000
ln *B/M*	0.092	0.039	0.017	0.189	0.018	0.000
ln *MV*	0.028	0.011	0.013	−0.018	0.023	0.431
ln *LM*12	−0.003	0.004	0.378	−0.011	0.005	0.028
ln *LEV*	0.145	0.022	0.000	0.131	0.039	0.001
INV/A	−0.402	0.076	0.000	−0.359	0.124	0.004
ROA	0.329	0.100	0.001	0.633	0.115	0.000
pAB	−0.094	0.024	0.000	−0.002	0.072	0.973
N	2879					
F	26.370			*F*	25.840	
P > F	0.000			*P > F*	0.000	
Adj R²	3.44%			*Adj R²*	4.03%	

Panel B: Differences in coefficients and firm characteristics

	Coefficient differences			Variable means		Characteristic differences		
	Beta diff	*SE*	*p*	*X SEO*	*X matches*	*X diff*	*SE*	*p*
Intercept	−0.182	0.082	0.027					
ln *B/M*	−0.097	0.043	0.023	−0.699	−0.723	0.024	0.011	0.020
ln *MV*	0.046	0.026	0.071	−0.596	−0.795	0.199	0.011	0.000
ln *LM*12	0.008	0.006	0.229	−7.685	−6.071	−1.614	0.062	0.000
ln *LEV*	0.014	0.044	0.744	−0.905	−0.875	−0.030	0.012	0.015
INV/A	−0.043	0.145	0.768	0.125	0.078	0.047	0.004	0.000
ROA	−0.304	0.152	0.046	−0.022	0.018	−0.040	0.003	0.000
pAB	−0.091	0.076	0.231					

least six months before the issue. *MV* and *LM*12 are measured one month before the issue. Accounting variables and *LM*12 are winsorised based on the CRSP population at ±1%.

The results show no relation between SEO long-run performance and pre-issue stock liquidity.[20] Larger issuers and issuers with higher B/M ratios earn higher post-issue returns. The positive coefficient on leverage confirms results in Eckbo *et al.* (2000) that increased leverage and a resultant higher exposure to default risk leads to higher realised rates of return for equity holders. The coefficient on *INV/A* is negative, consistent with Lyandres *et al.* (2008). As in Chen *et al.* (2010), higher profitability increases stock returns. A significant relation between SEO long-run returns and *pAB* suggests that stock prices do not fully impound publicly available information about firm misvaluation at the announcement date. Matching stocks' BHRs vary significantly with pre-issue *B/M, LM*12, *LEV, INV/A*, and *ROA*.

Table 4, Panel B examines the role of the discount rate effect, $X_i(\beta_1 - \beta_0)$, in explaining long-run SEO underperformance. We mimic the unobservable expected return on sample firm i in the non-issuing state by the return on a benchmark j, $E(R_{0i}|D_i = 0, X_i) = E(R_{0j}|D_j = 0, X_j)$. This leads to the discount rate effect being a function of differences in characteristics, $X_{0i} \neq X_{0j}$, and risk exposures, $\beta_1 \neq \beta_0$. Column *Beta diff* reports coefficient differences for the two regressions in Panel A. SEOs have significantly lower *B/M* and *ROA* coefficients and a higher *MV* coefficient than matching stocks. However, $d_1 - d_0$ remains significant at -18.2%.[21] This shows that controlling for differences in risk, SEOs underperform their control stocks. The last four columns of Panel B report mean firm characteristics for SEOs (*X SEO*), matches (*X matches*), and their differences (*X diff*) over the 3-year post-issue period.[22] SEOs are on average larger and more liquid than benchmark firms in the post-issue period with higher investment rates and book-to-market ratios, and lower gearing and profitability. With the exception of differences in post-issue *B/M* ratios, this suggests lower SEO expected returns than for control stocks. The difference in log *B/M* is small (0.024) and more than offset by a lower SEO *B/M* coefficient (0.092) compared to control firms (0.189).

Based on the results in Table 4, new equity issuers have lower post-issue risk than matching stocks, consistent with the discount rate hypothesis. However, controlling for risk, SEOs continue to underperform benchmark stocks, which suggests that a discount rate effect alone does not explain low issuer returns. Next, we turn to the conditional estimator of SEO abnormal returns to test the underreaction explanation for SEO post-offering performance.

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[20] Results in Table 4 use year- and industry-clustered standard errors and all variables are expressed as decimals rather than percentages in this and subsequent regressions.

[21] The -18.2% estimate of SEO abnormal performance in Table 4, Panel B, is not comparable with the -25.87% abnormal performance in Table 3, Panel A, as the former figure is the abnormal performance when the values of the risk characteristics, X_i, are set to zero.

[22] In calculating mean three-year post-issue characteristics we use all annual non-missing characteristics available for SEOs and control stocks. The table omits *pAB*, which relates to the pre-issue period. Table 5 below reports mean *pAB* for SEOs, matching stocks, and their difference before the issue.

6. Predicting the Issue Decision and Conditional Estimates of the Issue Effect

To obtain the conditional estimator of SEO abnormal returns in equation (9), we need λ_{1i} and λ_{0i} from the equity issue selection equation (4). We use Heckman's (1979) two-step procedure to estimate the equity issue decision and decompose SEO expected returns in the issue and non-issue states. The procedure uses a probit model to estimate the anticipated component of the issue decision, $Z_i\gamma$. To ensure the probit model uses the latest information available before the issue with no hindsight bias, we measure market-based explanatory variables one month before the event. The accounting variables are for December at least six months before the issue. Accounting variables and $LM12$ are winsorised based on the CRSP population at $\pm 1\%$. We group explanatory variables into five categories according to issue motives.

Firm overvaluation

Loughran and Ritter (1995) argue that stock mispricing encourages firms to issue overvalued equity. We use five variables to capture variation in firm mispricing. To measure pre-offering abnormal return performance we use *pAB*. A dummy variable, *Hot*, which equals 1 if the number of sample SEOs in the month before issue is above the median monthly number of sample SEOs over the previous 36 months and zero otherwise, captures waves of new equity issues as firms cluster offerings to exploit periodic stock mispricing (Loughran and Ritter, 2000). The variable *Hot* also captures Schultz's (2003) pseudo market timing hypothesis, which argues that equity issue waves coincide with peaks in stock market performance. Year dummies (*Year dummies*) and twelve industry dummies (*Industry dummies*) based on Kenneth French's industry definitions capture time and industry variation in mispricing. An indicator variable (*Nasdaq*) distinguishes Nasdaq from NYSE/AMEX listed firms.

Growth options

Carlson *et al.* (2006) and Li *et al.* (2009) argue that firms make SEOs to pursue profitable growth opportunities. We use *B/M* and *INV/A* to measure growth options. Harjat and Garen (2003) report that 42% of IPOs make SEOs within four years of their IPOs. Younger and smaller firms require more investment capital at the start of their life cycle. We measure firm age (ln *Age*) as the difference between a firm's first CRSP listing date and the issue date, in log form. We use ln *MV* to measure firm size.

Leverage and financial constraints

The pecking order theory predicts that firms with insufficient internal funds to finance new investment resort to external financing. We use earnings growth (*EG*), *ROA*, and the inverse of the ratio of capital expenditures to the change in retained earnings plus depreciation and amortisation (*IFC*) to measure a firm's ability to generate internal funds. Myers (1977), Jensen (1986), and Stulz (1990) point out that high leverage limits a firm's ability to exploit new investment opportunities. We use *LEV* to control for the higher propensity of high leverage firms to issue equity rather than debt to finance new projects.

Stock liquidity

Eckbo *et al.* (2000) point out that an equity issue may improve a stock's liquidity and reduce the firm's expected returns. Butler *et al.* (2005) report that investment banks charge lower fees to firms with more liquid stock before the offering. Higher pre-SEO liquidity can ensure a higher uptake of new shares, lowering issue costs. To capture the effect of stock liquidity on the equity issue decision, we use $LM12$.

Information releases

Korajczyk *et al.* (1991, 1992) predict that firms time equity issues to follow credible and significant information releases, which temporarily reduce information asymmetry between managers and investors. We create dummy variables (*Issue month dummies*) corresponding to calendar months.[23] Given the prevalence of December fiscal year-ends in the USA, we expect issues to cluster around the earnings announcement months of March to June.

To estimate the probit model we require a sample of non-issuing firms. To select this sample, we use a procedure similar to Guo and Mech (2000). We randomly choose 60,000 security month–years (based on a random number generator and selection without replacement) from the monthly CRSP/Compustat merged files over 1970–2004. Excluding firms with insufficient CRSP/Compustat data leaves a sample of 21,101 non-issuing firm–year observations. Adding to these observations our size–B/M benchmark stocks gives a sample of 23,980 pseudo non-issuing events. Size–B/M matched stocks share pseudo non-event dates with the sample of SEOs.

The conditional returns of SEOs and matches, equation (7) and (8), are estimated jointly with the equity issue selection model, equation (4). This requires exclusion restrictions to ensure identification of the return equations, as missing or low quality instruments may result in collinearity between lambda and the discount rate effect (Li and Prabhala, 2008). The conditional returns equations include variables that previous studies find control for SEO risk and publicly available information predicting equity mispricing. Nasdaq, industry, year, hot and issue month dummies, firm age, the inverse of the firm's ability to generate internal funds, and earnings growth from the equity issue choice model (equation 4) form the instrument set. Previous studies provide no evidence that any of the dummy variables predict stock returns, which justifies excluding them from the return regression.[24] A firm's ability to generate internal funds and earnings growth determine a firm's cash holding and its ability to finance new projects from internal as opposed to external sources.

Table 5, Panel A reports means, medians, and standard deviations of the variables that relate to the equity issue decision or control for risk for SEOs, matches, and the remaining CRSP stocks. The final four columns test for differences in characteristics

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[23] To avoid multicollinearity, the model excludes one year, one industry and one issue month dummy.

[24] As we exclude IPO firms from our sample, age should play no role in predicting stock returns. Ex post, the internet bubble makes the 2001 year dummy a predictor of low returns in 2002. At the firm-level, however, the 2001 dummy is likely to be a much weaker predictor of returns and including (weakly) endogenous variables as instruments can improve estimation efficiency (Larcker and Rusticus, 2010).

Table 5

Variables relating to the equity issue decision

Panel A reports means (*Mean*), standard deviations (*STD*) and medians (*Median*) of the variables that relate to the equity issue decision or control for risk for SEOs, matches, and the remaining CRSP stocks. Column *Diff S − M* (*Diff S − C*) reports differences in characteristics between SEOs and their control firms (SEOs and the remaining CRSP stocks). *p* is a *p*-value for differences. *Runup* is the previous 6-month buy-and-hold % return, *MKT return* is the previous six-month buy-and-hold return on the CRSP VW NYSE/AMEX/Nasdaq index in %, and *Nasdaq* equals 1 if the stock is listed on Nasdaq and zero otherwise. *Hot* equals 1 if the number of SEOs in a month preceding the issue is above the median monthly number of SEOs over the previous 36 months and zero otherwise. *MV* is market value of common equity in $m deflated by the S&P 500 market index, *B/M* is the B/M ratio, *INV/A* is the change in property plant and equipment plus the annual change in inventories scaled by lagged value of assets, *Age* is the number of years between the issue date and the firm's first CRSP listing date, *EG* is the current year's earnings growth in %, *IFC* is the inverse of internal funding (CAPEX/change in retained earnings plus depreciation and amortisation), *ROA* is return on assets in %, *LEV* is the ratio of firm total liabilities to total assets, and *LM12* is Liu's (2006) liquidity measure. Accounting variables (*B/M, INV/A, EG, IFC, ROA* and *LEV*) are for the prior fiscal year-end at least six months before the issue and, together with *LM12*, we winsorise them based on the CRSP population at ±1%. Market variables are measured one month before the issue. Panel B shows the Pearson correlation coefficients between the variables with *p*-values beneath. *N* is the number of observations.

Panel A: Descriptive statistics for the sample of SEOs, matches and remaining CRSP stocks

	SEOs (N = 2879)			Matches (N = 2879)			CRSP stocks (N = 21101)			SEOs − Matches		SEO − CRSP	
	Mean	STD	Median	Mean	STD	Median	Mean	STD	Median	Diff S − M	p	Diff S − C	p
Runup (%)	39.63	79.40	23.38	15.26	44.30	9.73	6.66	45.88	1.54	24.370	0.000	32.970	0.000
MKT return (%)	9.28	11.46	10.33	9.28	11.46	10.33	6.07	11.74	6.70	0.000	1.000	3.220	0.000
Nasdaq	0.534	0.499	1.000	0.494	0.500	0.000	0.458	0.498	0.000	0.040	0.002	0.076	0.000
Hot	0.803	0.398	1.000	0.803	0.398	1.000	0.527	0.499	1.000	0.000	1.000	0.276	0.000
MV	2.913	16.207	0.455	2.717	16.484	0.368	2.627	11.973	0.242	0.196	0.649	0.287	0.359
B/M	0.664	0.595	0.505	0.660	0.581	0.505	0.858	0.752	0.662	0.004	0.799	−0.194	0.000
INV/A	0.133	0.208	0.084	0.087	0.168	0.054	0.101	0.188	0.066	0.046	0.000	0.031	0.000
Age	11.492	9.167	8.504	14.011	9.621	11.459	12.084	8.913	9.910	−2.520	0.000	−0.592	0.001
EG (%)	10.86	184.82	14.59	5.94	144.01	8.94	3.69	164.58	8.91	4.920	0.259	7.170	0.048
IFC	−25.395	124.291	1.613	−9.158	107.624	4.147	−4.611	95.488	3.607	−16.237	0.000	−20.784	0.000
ROA (%)	−4.81	23.28	3.36	0.99	17.66	4.60	−0.12	17.32	3.93	−5.790	0.000	−4.690	0.000
LEV	0.502	0.216	0.531	0.477	0.218	0.486	0.491	0.209	0.503	0.025	0.000	0.010	0.015
LM12	4.812	15.871	0.000	8.467	24.730	0.000	17.336	37.495	0.000	−3.655	0.000	−12.524	0.000

Table 5

Continued.

Panel B: Pearson correlations between probit model explanatory variables

	Runup	MKT return	ln MV	ln B/M	INV/A	ln Age	EG	IFC	ROA	ln LEV
MKT return	0.300									
	0.000									
ln MV	0.110	0.048								
	0.000	0.000								
ln B/M	0.060	0.013	−0.142							
	0.000	0.029	0.000							
INV/A	−0.031	0.047	0.066	−0.126						
	0.000	0.000	0.000	0.000						
ln Age	0.001	0.008	0.304	0.168	−0.195					
	0.866	0.189	0.000	0.000	0.000					
EG	0.005	0.022	0.094	−0.039	0.109	0.001				
	0.427	0.000	0.000	0.000	0.000	0.876				
IFC	−0.050	0.008	0.149	0.174	0.068	0.098	0.029			
	0.000	0.207	0.000	0.000	0.000	0.000	0.000			
ROA	−0.024	0.026	0.304	0.175	0.125	0.203	0.076	0.407		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
ln LEV	−0.010	0.019	0.142	0.094	0.045	0.207	0.005	0.104	0.075	
	0.106	0.002	0.000	0.000	0.000	0.000	0.423	0.000	0.000	
ln LM12	−0.016	0.004	−0.602	0.276	−0.071	−0.135	−0.059	0.019	−0.019	−0.011
	0.008	0.554	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.079

between SEOs and their matches and between SEOs and CRSP stocks. SEOs exhibit higher six-month pre-issue price run-up than matching firms (39.63% vs. 15.26%) and the remaining CRSP stocks (6.66%). They are also more likely to list on Nasdaq than are matches and the remaining CRSP stocks. Size–B/M matching before the issue is successful, but compared to their matches and the remaining CRSP stocks, SEOs have significantly higher investment rates, leverage, financial constraints and liquidity, and lower profitability.[25] SEOs are younger than their matches and the remaining CRSP stocks, consistent with a higher reliance of younger firms on external capital. They also have significantly higher earnings growth compared to their matches and the remaining CRSP stocks and issues are more likely to cluster in periods of heavy issuing activity (*Hot* = 0.803 vs. 0.527). Table 5, Panel B reports Pearson correlations between the variables. The magnitudes of the correlations are low, being 0.068 on average.

Table 6 reports the results of modelling the issue decision using a probit model applied to 26,859 firm–year observations and shows positive and significant coefficients on *pAB*, *Nasdaq* and a number of year, issue, and industry dummies (not reported). Periods of heavy (prior) issuing activity increase the likelihood of an equity offering and in our sample, larger companies are more likely to issue equity. High growth options, investment rates, and being early in the corporate life cycle, increase the propensity to issue. There is partial support for the financial constraints prediction, with a negative coefficient on *ROA* but insignificant coefficients on *IFC* and *EG*. High firm leverage and liquidity increase the probability of an equity issue.[26]

The marginal effects (*ME*) indicate the importance of each variable in the issue decision. *INV/A* is the principal positive contributor to the issue decision (7.27%), indicating that firms issue equity to pursue new investment. This is consistent with DeAngelo *et al.* (2010), Loughran and Ritter (1997), and Lyandres *et al.* (2008), who report high SEO investment rates before and after the offering. As in Huang and Ritter (2009) and DeAngelo *et al.* (2010), we find less profitable firms with insufficient internal funds are more likely to issue, with a unit decrease in *ROA* contributing 6.25% to the probability of issue. These results are consistent with Myers and Majluf's (1984) rational equity issue model. Pre-issue abnormal performance, *pAB*, has a strong positive impact on the issue decision, which suggests managers are more likely to issue following recent price appreciation. Loughran and Ritter (2000, 362–363) argue that '[i]f there are time-varying misvaluations that firms capitalise on by taking some action (a supply response), there will be more events involving larger misvaluations in some periods than in others'. *Hot* has a positive influence on the issue probability, consistent with Loughran and Ritter's prediction.

Table 6, Panel B reports the predicted probability of an equity issue based on the estimates in Panel A for the sample of SEOs, matches, and the remaining CRSP stocks. A random non-issuing CRSP stock has an 8.92% probability of issuing equity in a given year. Matching firms have a higher issue probability (13.91%), while SEOs have the highest predicted issue probability (20.14%). Despite investors partly anticipating new

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[25] SEOs improve stock liquidity after the issue, which explains the lower *LM*12 value after the offering in Table 3.

[26] Unreported results show a significantly lower likelihood of equity issues in January and February. Straddling the (sample median) December fiscal year-end and the earnings announcement season (March), these months are likely to have higher levels of information asymmetry. Firms are also less likely to issue between July and October.

Table 6

Probability of an equity issue

Panel A reports probit estimates (*Estimate*) of a model where the dependent variable is a dummy variable equal to 1 for firms making an SEO in a year and 0 otherwise. *pAB* is the difference between the firm's and the market's prior six-month buy-and-hold return, *Nasdaq* equals 1 if the stock lists on Nasdaq and 0 otherwise. *Hot* equals 1 if the number of SEOs in a month preceding the issue is above the median monthly number of SEOs over the previous 36 months and zero otherwise. *MV* is the market value of common equity in \$m deflated by the S&P 500 market index, *B/M* is the B/M ratio, *INV/A* is the change in property plant and equipment plus the annual change in inventories scaled by lagged value of assets, *Age* is the number of years between the issue date and the firm's first CRSP listing date, *EG* is the current year's earnings growth, *IFC* measures the inverse of internal funding (CAPEX/change in retained earnings plus depreciation and amortisation), *ROA* is return on assets, *LEV* is the ratio of firm total liabilities to total assets, and *LM*12 is Liu's (2006) liquidity measure. The model includes issue month, year and industry dummies using definitions from Kenneth French's webpage. Accounting variables (*B/M*, *INV/A*, *EG, IFC, ROA* and *LEV*) are for the prior fiscal year-end allowing for a six month reporting gap and, together with *LM*12, are winsorised based on the CRSP population at ±1%. Market variables (*pAB, Hot, MV,* and *LM*12) are measured one month before the issue. *Pred sign* shows the predicted direction of the relation. *SE* denotes standard errors, and *p* the *p*-value based on *z*-statistics. Column *ME* measures the percentage marginal effects for a unit change in the explanatory variables. Panel B shows the model mean predicted probability of equity issue for CRSP stocks, the sample of SEOs, and their matches.

Panel A: Estimates of the probability of equity issue

	Pred sign	Estimate	ME (%)	SE	p
Intercept		−0.869		0.088	0.000
pAB	+	0.450	6.40	0.020	0.000
Nasdaq	+	0.102	1.45	0.031	0.001
Hot	+	0.380	5.19	0.033	0.000
ln *MV*	−	0.084	1.19	0.009	0.000
ln *B/M*	−	−0.068	−0.97	0.015	0.000
INV/A	+	0.511	7.27	0.059	0.000
ln *Age*	−	−0.105	−1.49	0.016	0.000
EG	−	0.004	0.06	0.007	0.552
IFC	−	0.000	0.00	0.000	0.198
ROA	−	−0.440	−6.25	0.066	0.000
ln *LEV*	+	0.103	1.47	0.022	0.000
ln *LM*12	−	−0.013	−0.18	0.003	0.000
Issue month dummies		Not reported			
Year dummies		Not reported			
Industry dummies		Not reported			
Number of event observations	2879				
Number of non-event observations	23980				
χ^2	2607				
p-value	0.000				
Pseudo R^2	14.24%				

Panel B: Predicted probability of equity issue

	N	Mean (%)	SE	p
SEOs predicted probability	2879	20.14	0.003	0.000
Matches predicted probability	2879	13.91	0.002	0.000
CRSP predicted probability	21101	8.92	0.001	0.000
SEOs − Matches	2879	6.22	0.002	0.000

equity issues, the results suggest that SEOs surprise the market. Intuitively, even though investors rate certain stocks as being on average twice as likely to *issue* equity than an average (non-issuing) stock, *not issuing* is four times as likely even for these stocks. If investors are rational, stock prices should, on average, impound a fifth of the total issue effect before the offering with the issue announcement revealing the remaining 80% arising from managerial private information. Investors should discount this surprise component immediately and fully (see Figure 1a). If SEO stock prices do not react fully to managerial private information, there will be a negative relation between managerial information revealed at the announcement and post-issue stock returns.

Results in Table 6 underscore the importance of the unobservable private information in driving the issue decision. If investors behave less-than-rationally, our private information measure, lambda, will be a strong determinant of post-issue return. This suggests that tests of the underreaction hypothesis that relate publicly available information before the issue, e.g. abnormal price performance, rather than lambda to post-issue SEO returns have low power.

6.1 *The long-run performance of SEOs – conditional estimates*

The probit model results confirm that equity offerings are unexpected events and issue announcements convey significant information about managers' private information, u_{di}, that is unobservable before the announcement. If the market rationally impounds this information, there should be a complete and unbiased price reaction at the issue announcement and post-offering stock returns should compensate for risk. If the market initially underreacts to the information and gradually corrects the overvaluation after the event, we should observe post-offering underperformance and post-issue correction should be larger for less anticipated SEOs.

Table 7, Panel A reports results for the conditional estimator of abnormal returns for SEOs and their control stocks, where the inverse Mills ratios (λ_0, λ_1) proxy for unobservable private information.[27] As predicted, the coefficient on λ_1 is significantly negative (-0.165, $p = 0.028$), indicating that greater private information leads to lower post-event performance.[28] A one-standard deviation increase in lambda (0.384) leads to a 6.33% lower SEO buy-and-hold return over the three years after the issue. SEO performance varies positively with pre-issue *B/M, MV* (at 10%), *LEV,* and *ROA,* and negatively with *INV/A* and *pAB*. There is no relation between private information and average returns for matching stocks, consistent with the random assignment of pseudo-event dates and lambda measuring only information revealed by managers at equity issue announcements.[29] Similar to SEOs, long-run BHRs of matching stocks are positively related to pre-issue *B/M*, *LEV,* and *ROA,* and negatively related to *INV/A* and stock illiquidity (at 10%).

Table 7, Panel B reports mean λ_1 and λ_0, and Pearson correlations between lambdas and the explanatory variables for SEOs and matching stocks. Mean lambda for SEOs is

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[27] Including intercept terms captures any misspecification of the empirical model due to a failure to control for a delayed market reaction when comparing SEO and benchmark stock performance.

[28] Asymptotically consistent standard errors adjust for inclusion of first-stage predictors in the model.

[29] Table 9 reports further tests of lambda's validity in capturing only the SEO announcement effect, using the random non-issuer sample from the equity issue choice model in Table 5.

Table 7

Regressions of buy-and-hold returns with private information adjustment

Panel A reports regression estimates (*Estimate*) for equations (7) and (8), where the dependent variable is the SEO's or the match's three-year buy-and-hold return. The explanatory variables are the B/M ratio (*B/M*), total market capitalisation in $m deflated by the S&P 500 market index (*MV*), Liu's (2006) liquidity measure (*LM*12), leverage (*LEV*), all in log form, investment-to-assets (*INV/A*), return on assets (*ROA*) and pre-issue abnormal performance (*pAB*). *MV, LM*12 and *pAB* are measured one month before the issue. *B/M, LEV, INV/A* and *ROA* are for the prior fiscal year-end at least six months before the issue and, together with *LM*12, are winsorised based on the CRSP population at $\pm 1\%$. λ_0, λ_1 are the inverse Mills ratios from the equity issue model, proxying for managerial private information revealed by the issue announcement. *SE* denotes asymptotically consistent standard errors, and *p* gives the corresponding *p*-values. *N* is the number of observations, *F* and *P > F* are the *F*- and corresponding *p*-values for model specification, *Adj R²* is the adjusted R-square, *rho* is the correlation between the residuals in the issue selection equation (4) and unconditional expected post-issue returns for SEOs/matches (equations 1 and 2). *Sigma* is the standard error of residuals for the expected returns equations (1) and (2). Panel B reports mean lambda and Pearson correlation coefficients between lambda and other explanatory variables. Panel C shows the difference in coefficients between SEOs and control stocks (*Beta diff*). *SE* stands for standard errors and *p* is a *p*-value for the significance of the differences.

Panel A: Conditional issue effect

	SEOs			Matches		
	Estimate	*SE*	*p*	*Estimate*	*SE*	*P*
Intercept	0.724	0.140	0.000	0.576	0.062	0.000
ln *B/M*	0.096	0.023	0.000	0.194	0.025	0.000
ln *MV*	0.024	0.014	0.090	−0.019	0.015	0.182
ln *LM*12	0.000	0.005	0.995	−0.009	0.005	0.072
ln *LEV*	0.139	0.035	0.000	0.127	0.036	0.000
INV/A	−0.463	0.102	0.000	−0.391	0.130	0.003
ROA	0.420	0.107	0.000	0.687	0.136	0.000
pAB	−0.145	0.038	0.000	−0.053	0.066	0.419
λ_1	−0.165	0.075	0.028			
λ_0				−0.231	0.192	0.231
N	2879					
F	14.310			*F*	16.170	
P > F	0.000			*P > F*	0.000	
Adj R²	3.56%			*Adj R²*	4.04%	
rho	−0.154			*rho*	−0.204	
Sigma	1.073			*Sigma*	1.131	

Panel B: Mean lambda and Pearson correlations between lambda and explanatory variables

	Mean lambda	ln *B/M*	ln *MV*	In *LM*12	ln *LEV*	*INV/A*	*ROA*	*pAB*
λ_1	1.485	0.125	−0.149	0.331	0.038	−0.135	0.302	−0.523
p	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.000
λ_0	−0.252	0.152	−0.187	0.333	−0.053	−0.119	0.284	−0.572
p	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000

Table 7

Continued.

Panel C: Differences in regression coefficients

	Intercept	ln *B/M*	ln *MV*	ln *LM*12	ln *LEV*	*INV/A*	*ROA*	*pAB*
Beta diff	0.149	−0.098	0.043	0.009	0.011	−0.072	−0.267	−0.092
SE	0.153	0.034	0.020	0.007	0.050	0.165	0.173	0.076
p	0.332	0.004	0.033	0.199	0.820	0.662	0.123	0.228

significantly higher than for matching stocks (1.485 vs. −0.252), which confirms the amount of private information revealed by managers at the SEO announcement.[30] All correlations are significant, with the average absolute correlation between lambda and the explanatory variables being 0.229 (0.243) for SEOs (matches).

Table 7, Panel C reports coefficient differences between the two Panel A regressions and tests their significance. Including lambda in the conditional return regressions, we find no indications of SEO underperformance, with the intercept difference being indistinguishable from zero. Coefficient differences between regressions of SEOs and matches show similar significance levels to Table 4, Panel C, except for *ROA*, which is indistinguishable from zero. This suggests unconditional estimates in Table 4 understate lower SEO post-issue risk exposure compared to benchmark stocks due to omitting lambda, i.e. $X_i(\hat{\beta}'_1 - \hat{\beta}'_0) < X_i(\hat{\beta}_1 - \hat{\beta}_0)$.

From Table 7, we can obtain an unbiased and consistent estimate of issuer underperformance due to investor underreaction. From equation (9), we estimate SEO underperformance as the difference between the products of the covariance and lambda estimates for SEOs and matching stocks, $\hat{\sigma}_{u_d u_1}\hat{\lambda}_{1i} - \hat{\sigma}_{u_d u_0}\hat{\lambda}_{0i}$, plus the difference between SEO and matching stock intercepts.[31] This gives an SEO underperformance estimate due to investor underreaction over the three years after the issue of −15.43%, which accounts for 59% of the −25.87% abnormal performance in Table 3. Lower SEO risk exposure after the issue leads to abnormal performance of −10.44% relative to size–B/M control stocks, which confirms that investor delay in impounding the information surprise at the issue announcement is the main generator of SEO abnormal performance.[32]

Overall, the results in Table 7 confirm the hypothesis that a delayed reaction to managers' private information revealed by the equity issue leads to negative post-issue abnormal performance. After the offering, there is a negative relation between SEO stock returns and managers' private information but there is no relation between private information and average returns for matching stocks.

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[30] The lambda coefficients in Table 7, Panel A adjust for higher SEO than control firm mean lambda (1.485 vs. −0.252), which explains higher point estimate magnitudes for λ_{0i} (−0.231) than λ_{1i}(−0.165).

[31] The intercepts capture potential misspecification of the empirical model in Table 6 and their difference has zero expectation.

[32] A sensitivity analysis shows that a 10% higher lambda coefficient increases the share of SEO underperformance attributable to investor underreaction from the current level of 59% to 69%. A lambda coefficient of −0.235 means investor irrationality accounts for nearly 100% of total SEO underperformance and is the upper bound for a 'reasonable' lambda estimate.

6.2 *Sensitivity analysis*

Table 7 shows a significant negative relation between SEO long-run returns and managers' private information revealed by the announcement, proxied by λ_1. This suggests that investors only partially discount the information surprise at the issue announcement and this underreaction corrects over a post-offering period. Next, we examine the sensitivity of the results to pre-issue abnormal return performance, SEO attrition before the end of the holding period, delisting returns, and periods of high equity issue volume.

If higher investor optimism about firm prospects leads to greater stock overvaluation, we should find greater underperformance for SEOs preceded by higher stock price performance. Table 8, Panel A tests this prediction, where we report regression results for SEOs with high and low pre-issue abnormal performance.[33] While λ_1 is insignificant for low *pAB* SEOs, high *pAB* SEOs have a significant λ_1 coefficient of -0.194; a one-standard deviation increase in lambda (0.47) for high *pAB* SEOs leads to a 9.13% lower buy-and-hold return over the three years after the issue. These results support the prediction that investors underreact more to SEO announcements preceded by a strong price run-up.

Shumway (1997) and Shumway and Warther (1999) address the impact of omitting delisting returns on stock return calculations. Both studies find that including delisting returns can significantly alter inferences on many anomalies. For example, Shumway and Warther (1999) find that correcting for delisting bias eliminates the size effect for Nasdaq stocks. Beaver *et al.* (2007) confirm that including delisting returns increases the average return difference between extreme decile portfolios partitioned on earnings, cash flows, and B/M ratio. To ensure omitting delisting returns does not affect our results, we repeat our analysis using CRSP delisting returns. Where a delisting return is missing, we assume a return of -1 for delisting due to liquidation (CRSP codes 400–490), -0.33 for performance related delisting (500 and 520–584), and zero otherwise. Using delisting returns has virtually no effect on coefficient estimates indicating that our findings are robust to delisting bias (results not tabulated). This is consistent with Shumway (1997) who finds a less than 1% per year difference in three-year underperformance estimates for NYSE/AMEX listed IPOs after adjusting for delisting bias.

SEO attrition before the end of the three-year holding period may affect our results. For example, low buy-and-hold returns over the 36–month post-issue period can result from delayed market reaction or from firm attrition due to bankruptcy or acquisition. If the delisting probability depends on λ_1, low estimated returns may be due to intervening events rather than to a delayed market reaction to an SEO announcement. There are 2,419 SEOs with 36 months of returns. For 455 SEOs the CRSP files identify the reason for delisting before the end of the three-year holding period: 285 delist due to mergers/acquisitions, 157 are delisted by their exchange (NYSE/AMEX/Nasdaq), and 13 delist due to an exchange of shares for another type of asset. While it involves a hindsight bias, we repeat our analysis using only SEOs that survive to the end of the three-year holding period (results not tabulated). The results are qualitatively similar to

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[33] We estimate subsample cross-sectional regressions jointly with the equity issue model (equation 4) to ensure consistent standard error estimates. The results are indistinguishable from regression estimates that use the original lambda estimates from Table 6. For example, the percentage difference in SEO lambda coefficients for the two approaches is 3.87% for high *pAB* in Table 8, Panel A.

Table 8

Sensitivity analysis

Panel A reports regression estimates (*Estimate*) for SEOs split into *High* and *Low* groups based on pre-issue abnormal performance (*pAB*). The dependent variable is the SEO's three-year buy-and-hold return. The explanatory variables are the B/M ratio (*B/M*), total market capitalisation in \$m deflated by the S&P 500 market index (*MV*), Liu's (2006) liquidity measure (*LM*12), leverage (*LEV*), all in log form, investment-to-assets (*INV/A*), return on assets (*ROA*) and pre-issue abnormal performance (*pAB*). *MV, LM*12 and *pAB* are measured one month before the issue. *B/M, LEV, ROA* and *INV/A* are for the prior fiscal year-end at least six months before the issue and, together with *LM*12, are winsorised based on the CRSP population at $\pm 1\%$. λ_1 is the inverse Mills ratio from the equity issue model, proxying for managerial private information. *SE* denotes asymptotically consistent standard errors and *p* is the *p*-value. *N* is the number of observations, *F* and $P > F$ are the *F*- and corresponding *p*-values for model specification, *Adj R^2* is the adjusted R-square, *rho* is the correlation between residuals in the issue selection equation (4) and unconditional expected post-issue returns for SEOs. *Sigma* is the standard error of the residuals for unconditional SEO expected returns. Panel B shows regression estimates for SEOs made during high (*Hot*) and low (*Cold*) issue volume months, where an issue month is *Hot* (*Cold*) if the number of sample SEOs in a month preceding the issue is above (below) the median monthly number of sample SEOs over the previous 36 months.

Panel A: Grouping SEOs by pre-issue abnormal performance

	High *pAB*				Low *pAB*		
	Estimate	SE	p		Estimate	SE	p
Intercept	0.874	0.194	0.000		0.640	0.215	0.003
ln *B/M*	0.104	0.029	0.000		0.069	0.037	0.060
ln *MV*	0.016	0.020	0.416		0.011	0.022	0.633
ln *LM*12	0.001	0.006	0.850		−0.006	0.008	0.417
ln *LEV*	0.148	0.042	0.000		0.124	0.058	0.031
INV/A	−0.529	0.130	0.000		−0.407	0.154	0.009
ROA	0.498	0.129	0.000		0.272	0.167	0.103
pAB	−0.209	0.054	0.000		0.460	0.192	0.017
λ_1	−0.194	0.089	0.030		−0.124	0.105	0.236
N	1439			*N*	1440		
F	11.030			*F*	5.700		
$P > F$	0.000			$P > F$	0.000		
Adj R^2	5.28%			*Adj R^2*	2.54%		
rho	−0.206			*rho*	−0.105		
Sigma	0.940			*Sigma*	1.187		
Mean pAB	70.59%			*Mean pAB*	−10.01%		
Median pAB	45.85%			*Median pAB*	−4.98%		

Panel B: SEOs in hot and cold issuing periods

	Hot				Cold		
	Estimate	SE	p		Estimate	SE	p
Intercept	1.096	0.178	0.000		1.356	0.475	0.005
ln *B/M*	0.118	0.024	0.000		0.076	0.073	0.303
ln *MV*	0.025	0.015	0.092		−0.034	0.042	0.416

Table 8

Continued.

	Hot			Cold		
	Estimate	*SE*	*p*	*Estimate*	*SE*	*p*
ln *LM*12	0.006	0.005	0.258	−0.008	0.013	0.547
ln *LEV*	0.125	0.036	0.001	0.152	0.102	0.135
INV/A	−0.495	0.110	0.000	−0.870	0.297	0.004
ROA	0.491	0.116	0.000	0.722	0.329	0.029
pAB	−0.221	0.044	0.000	−0.175	0.111	0.116
λ_1	−0.403	0.101	0.000	−0.440	0.433	0.310
N	2311			*N*	568	
F	14.970			*F*	2.480	
P > F	0.000			*P > F*	0.012	
Adj R²	4.61%			*Adj R²*	2.06%	
rho	−0.391			*rho*	−0.310	
Sigma	1.032			*Sigma*	1.421	

those in Table 7, Panel A. Coefficient signs and significance are similar for the sample without return attrition.

Loughran and Ritter (2000) report greater underperformance following periods of heavy issuing activity. If time-varying investor optimism (sentiment) about firm prospects leads to mispricing of a group of stocks and consequent equity issue waves, greater underreaction to managerial private information can lead to greater underperformance following periods of high issue volume. Table 8, Panel B reports conditional estimates of the issue effect in hot and cold issuing periods.[34] There are 2,311 equity offerings in hot and 568 in cold issue periods. SEOs in hot periods have a λ_1 coefficient of −0.403, while λ_1 is indistinguishable from zero in cold periods. The downward trend in λ_1 in moving from low to high issue volume months and relative to the pooled sample in Table 7, Panel A is consistent with investors underreacting more to SEO announcements made during hot issue periods.

6.3 *Empirical model specification*

Using lambda to proxy for managers' private information inevitably leads to the joint hypothesis of underreaction and the validity of the model used to estimate lambda. Misspecification of equation (4) may result in lambda picking up publicly available information affecting a wide cross-section of returns, in addition to SEO-specific managerial private information. We test the specification of lambda by relating it to three-year buy-and-hold returns of random non-issuer samples from the equity issue choice model in Table 6 (excluding size–B/M benchmark stocks). Table 9 shows results for 20,783 non-issuing stocks with non-missing returns after the pseudo event date and three random subsamples of 5,000 stocks each. There is no association between lambda

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[34] In calculating hot issue periods for 1970–1972, we append our initial SEO sample with annual data from Eckbo *et al.* (2000). We convert the annual to monthly estimates assuming equal monthly issue frequencies.

Table 9

Sensitivity analysis: empirical model specification

This table reports regression estimates (*Estimate*) for a random sample of non-issuing CRSP stocks from the equity issue decision in Table 6 and three random subsamples of 5,000 stocks. There are 20,783 non-issuing stocks (excluding size–B/M benchmark stocks) with non-missing returns. The dependent variable is the non-issuer's three-year buy-and-hold return. The explanatory variables are the B/M ratio (*B/M*), total market capitalisation in $m deflated by the S&P 500 market index (*MV*), Liu's (2006) liquidity measure (*LM*12), leverage (*LEV*), all in log form, investment-to-assets (*INV/A*), return on assets (*ROA*) and pre-issue abnormal performance (*pAB*). *MV, LM*12 and *pAB* are measured one month before the issue. *B/M, LEV, ROA* and *INV/A* are for the prior fiscal year-end at least six months before the issue and, together with *LM*12, are winsorised based on the CRSP population at $\pm 1\%$. λ_0 is the inverse Mills ratio from the equity issue model, proxying for managerial private information. *p* is the *p*-value based on asymptotically consistent standard errors. *N* is the number of observations, *F* and $P > F$ are the *F*- and corresponding *p*-values for model specification, *Adj R*^{2} is the adjusted R-square, *rho* is the correlation between residuals in the issue selection equation (4) and unconditional expected post-event returns for non-issuing stocks. *Sigma* is the standard error of residuals for unconditional expected returns.

	All non-issuers		Random sample 1		Random sample 2		Random sample 3	
	Estimate	*p*	*Estimate*	*p*	*Estimate*	*p*	*Estimate*	*p*
Intercept	0.646	0.000	0.610	0.000	0.633	0.000	0.604	0.000
ln *B/M*	0.148	0.000	0.125	0.000	0.172	0.000	0.174	0.000
ln *MV*	−0.008	0.275	0.015	0.013	0.001	0.915	−0.006	0.389
ln *LM*12	0.000	0.943	0.006	0.003	−0.002	0.482	0.000	0.924
ln *LEV*	0.066	0.001	0.000	0.993	0.102	0.000	−0.003	0.864
INV/A	−0.241	0.000	−0.295	0.000	−0.052	0.375	−0.289	0.000
ROA	0.289	0.000	0.436	0.000	0.400	0.000	0.314	0.000
pAB	−0.013	0.685	−0.017	0.529	−0.038	0.199	−0.049	0.095
λ_0	0.120	0.269	0.132	0.135	−0.027	0.783	0.072	0.460
N	20783		5000		5000		5000	
F	29.400		10.470		10.060		10.470	
$P > F$	0.000		0.000		0.000		0.000	
Adj R^2	1.08%		1.49%		1.43%		1.49%	
rho	0.073		0.099		−0.018		0.049	
Sigma	1.630		1.328		1.485		1.467	

and non-issuer stock returns. This suggests proper specification of the empirical model in equation (4) and supports our main conclusions.

Results for non-issuing stocks in Table 7, Panel A and Table 9 allow us to address the classic problem of the SEO and IPO underperformance literature that a factor explaining SEO underperformance can proxy for stock misvaluation or risk (Brav and Heaton, 2002). For example, Lyandres *et al.* (2008, p. 2830) acknowledge that sentiment can also explain the relation between their investment factor and issuer returns: 'Following Fama and French (1993, 1996), we interpret the investment factor as a common factor of stock returns.... We do not take a stance on the risk interpretation of the investment factor.... General equilibrium models with behavioural biases (e.g., Barberis *et al.*, 2001), however, also can motivate the investment factor. Moreover, investor sentiment

can presumably affect investment policy through shareholders' discount rates (e.g., Polk and Sapienza, 2009).' Our results support only the behavioural explanation for the relation between lambda and post-issue SEO returns.

7. How Long Is the Delayed Market Reaction?

The previous analysis uses three-year buy-and-hold returns as the dependent variable. To estimate the length of the (delayed) reaction to SEO announcements, we re-run the regressions varying the buy-and-hold return period and measuring the relation with lambda.

To gauge how quickly the market discounts the announcement date information, Table 10 reports lambda coefficients from regressions where we increase the start date for measuring post-issue buy-and-hold returns by one month but fix the end of the holding period at month 36 after the offering. If stock price fully impounds u_{di} by month τ after the issue, we should find no relation between lambda and buy-and-hold returns over months τ to 36.[35] The results suggest that investors impound the negative announcement date information into stock price over a shorter period after the offering than the five-year period that Loughran and Ritter (1995) suggest. There is a significant negative relation between lambda and post-offering long-run returns for SEOs over the course of 16 months after the issue (at 5.8% significance). This is consistent with the period of negative SEO returns in Table 3, Panel B. Following the 16-month period after the issue, low risk explains low SEO returns.[36] A sixteen month period to discount managerial information is consistent with the length of irrational investor behaviour around other corporate events.

8. Conclusions

Loughran and Ritter (1995) and Spiess and Affleck-Graves (1995) argue that managers act on their private information about stock overvaluation in making SEOs, but investors underreact to the issue announcement and stock mispricing persists at the issue date. The market revalues the stock over an extended period following the offering, leading to negative post-offering abnormal returns. We use the inverse Mills ratio (lambda) from a probit model of the issue decision based on publicly available information, to proxy for managers' private information revealed by the issue announcement. Less anticipated SEO announcements have higher surprise components, implying greater stock overvaluation and giving higher lambdas. To test the underreaction hypothesis, we relate lambda to long-run post-issue returns.

This study documents average SEO abnormal returns of -25.87% relative to size–B/M non-issuing stocks over the three years after the issue for a sample of 2,879 equity issues in the US over 1970–2004. SEO underperformance decomposes into a -15.43% abnormal

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[35] To ensure consistent standard errors, we estimate the probit and the cross-sectional regressions each event month.

[36] The evidence in Ang and Zhang (2004) that the power of calendar time Fama–French factor regressions decreases sharply with the event horizon coupled with our evidence that SEO underperformance corrects within 16 months after the issue underlines doubts about the power of tests that use calendar time factor regressions with a five-year holding period to detect SEO abnormal performance.

Table 10

The speed of correction to private information

This table reports lambda estimates (*Lambda estimate*), where the start date for measuring post-issue SEO buy-and-hold returns increases by one month, holding the period end fixed at month 36 after the issue. Lambda is the inverse Mills ratio, based on the equity issue model in Table 6, and proxies for the magnitude of pre-event information asymmetry. The dependent variable is the SEO's three-year buy-and-hold return. The explanatory variables (not reported here) are the B/M ratio (*B/M*), total market capitalisation in $m deflated by the S&P 500 market index (*MV*), Liu's (2006) liquidity measure (*LM*12), leverage (*LEV*), all in log form, investment-to-assets (*INV/A*), return on assets (*ROA*) and pre-issue abnormal performance (*pAB*). *MV, LM*12 and *pAB* are for one month before the event date. *B/M, LEV, ROA* and *INV/A* are for the prior fiscal year-end at least six months before the offering date and, together with *LM*12, are winsorised based on the CRSP population at $\pm 1\%$. *Period* shows the buy-and-hold returns holding period and *N* is the number of observations. *SE* and *p* are the asymptotic standard errors and associated *p*-values.

Period	N	Lambda estimate	SE	p
0–36	2879	−0.165	0.075	0.028
1–36	2834	−0.199	0.074	0.008
2–36	2822	−0.190	0.073	0.010
3–36	2808	−0.207	0.075	0.006
4–36	2790	−0.225	0.075	0.003
5–36	2783	−0.241	0.074	0.001
6–36	2774	−0.206	0.068	0.002
7–36	2755	−0.198	0.069	0.004
8–36	2729	−0.183	0.065	0.005
9–36	2717	−0.187	0.067	0.005
10–36	2701	−0.184	0.070	0.008
11–36	2679	−0.186	0.070	0.008
12–36	2661	−0.156	0.069	0.024
13–36	2635	−0.153	0.067	0.022
14–36	2630	−0.152	0.063	0.016
15–36	2615	−0.149	0.064	0.020
16–36	2600	−0.115	0.061	0.058
17–36	2584	−0.095	0.063	0.128
18–36	2570	−0.062	0.062	0.319
19–36	2542	−0.029	0.059	0.621
20–36	2534	−0.013	0.061	0.835
21–36	2515	−0.013	0.057	0.823
22–36	2495	−0.026	0.055	0.639
23–36	2482	−0.020	0.055	0.712
24–36	2466	−0.025	0.051	0.626
25–36	2453	−0.019	0.050	0.709
26–36	2431	−0.031	0.045	0.488
27–36	2418	−0.033	0.043	0.441
28–36	2400	−0.025	0.038	0.513
29–36	2385	−0.026	0.037	0.480
30–36	2369	−0.029	0.037	0.432
31–36	2356	−0.028	0.035	0.415
32–36	2345	−0.035	0.025	0.155

Table 10
Continued.

Period	N	Lambda estimate	SE	p
33–36	2330	−0.011	0.021	0.598
34–36	2324	−0.005	0.017	0.766
35–36	2310	−0.020	0.013	0.147

performance due to investor underreaction to managers' private information revealed by the issue announcement and a −10.44% return performance due to lower SEO risk exposure after the issue. After the equity offering, issuers are larger, more liquid, with higher investment rates and book-to-market ratios, and lower gearing and profitability than their size and B/M peers. Investor underreaction to the announcement corrects within the first 16 months after the offering. Lower risk explains SEO performance after that point.

Our evidence confirms that a delayed reaction to information in the issue announcement is the main generator of SEO abnormal performance. The result is robust to controlling for the effects of pre-issue abnormal performance, SEO return attrition before the end of the holding period, delisting returns, periods of high equity issue volume, and tests for model misspecification.

The study's research framework is applicable to any corporate event where the endogenous decision to participate depends on managers' private information and investors do not fully react to the announcement date signal. Event studies that examine long horizon effects of stock repurchases and stock financed acquisitions are two examples where the framework can lead to insights. We encourage more European evidence on the length and magnitude of issuer underperformance due to less-than-rational investor behaviour. Institutional and regulatory differences make Europe-centered research an ideal setting for out-of-sample tests.

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