# The Effect of Market Conditions on Initial Public Offerings[1]

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Abstract

A simple model is developed in the paper in which two market conditions change over time: (i) investor sentiment or price-insensitive demand; and (ii) feedback trader risk or the propensity of investors to chase trends. The model shows that these conditions partially explain the three anomalies associated with the IPO market: (i) underpricing; (ii) windows of opportunity for new issues and (iii) long-term underperformance. The model is tested using a sample of firm commitment IPOs over the 1975-1987 period. The paper finds that the predictions of the model are largely borne out in the data.

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Why are initial public offerings (IPOs) underpriced (Ibbotson (1975)) and why does the average underpricing vary over time? Why do IPOs come to market in clusters creating the appearance that firms are taking advantage of windows of opportunity (Ibbotson and Jaffe (1975))? Why do IPOs perform poorly in the long run (Ritter (1991))? There are many models with rational agents which explain why underpricing occurs.[2] Most of these, however, are based on idiosyncratic factors specific to a firm - for example, the information asymmetry between issuer and potential investors. Consequently, they do not explain why there are market-wide cycles in underpricing.[3] Some economists have offered explanations for the long term underperformance of IPOs and fluctuations in the number of IPOs coming to market. Seyhun (1992) concludes from the trading patterns of insiders in IPOs that ex-post bad luck cannot explain the poor long run performance of IPOs, because insiders seem to be able to identify the issues that will fare badly. He argues that poor long run performance is due to the fact that offerings are bought at too high a price.[4] Loughran and Ritter (1995) show that the volume of IPOs is highest near market peaks and there is greater underperformance following high volume. In other words, firms take advantage of a time varying propensity of investors to overpay. The recent boom and bust of the IPO market, which was mainly driven by internet and high-technology companies is a good example of this propensity (Ritter and

[2] Allen and Faulhauber (1989), Baron and Holmstrom (1980), Benveniste and Spindt (1989), Beatty and Ritter (1986), Carter and Manaster (1990), Grinblatt and Hwang (1989), Rock (1986), and Welch (1989, 1992) offer explanations based on asymmetric information between one class of participants in the IPO process and another. Tinic (1988) argues that underpricing is a response to legal penalties, and Hughes and Thakor (1992) develop models where the threat of litigation could lead to underpricing under certain circumstances. Brennan and Franks (1997), Habib and Ljunqvist (2001), Aggarwal, Krigman, and Womack (2002), and Loughran and Ritter (2001, 2002) focus on agency-based explanations. Ritter (2001) and Ritter and Welch (2002) review the theories.

[3] But, see Nanda (1990) who argues that cyclical conditions in the real economy result in cyclical investment opportunities and consequently market-wide cyclicality in information asymmetries. Whether the magnitude of the cyclical fluctuations in information asymmetries can explain the fluctuations in volume and underperformance is an open question.

[4] Schultz and Zaman (2001), on the other hand, find no evidence of insider selling in internet-related IPOs.

Welch (2002)).

This paper starts with the hypothesis that all three phenomena -- cycles in underpricing, long run underperformance, and fluctuations in IPO volume -- are related to common factors. This link, between underpricing and the latter two phenomena, has received relatively little attention.[5] The reason may lie in the fact that while there are plausible explanations of underpricing based on the behavior of rational agents (though these may not explain the cycles), explanations of fluctuations in IPO volume and long run underperformance hint at some form of irrational behavior by investors. Since the irrational behavior is not specifically modelled, the links between the phenomena are hard to see. Therefore, we begin by writing down a simple model where some investors are irrational (or quasi-rational) in specific ways, and we establish how the three phenomena are related to the common irrationalities.

A potential criticism of explicit models relying on irrational behavior is that a specific form of irrationality can be set up to explain every phenomenon, and consequently these models explain nothing. This is not to say that irrational or quasi-rational explanations of what are anomalies in the traditional economist's rational model should not be given a fair trial. What is important, however, is that with a limited number of degrees of freedom the 'irrational' economist should derive a number of testable implications that exceed the degrees of freedom. This makes the models of irrationality falsifiable, and perhaps more acceptable. Clearly, there are fewer restrictions on the kind of behavior the 'irrational' economist can assume (though the variety of agency costs assumed in the corporate finance literature or the utility functions assumed in the equity premium literature suggest that this is not a monopoly of the 'irrational' economist). But here it is imperative that the 'irrational' economist provide additional direct evidence that the suggested behavior is plausible.

[5] See, however Ljunqvist, Nanda, and Singh (2001).

In our model two specific forms of irrationality are time-varying; we assume that the fraction of investors who chase trends (also called positive feedback traders) varies over time, and that investors have a propensity to overpay for the stocks of certain industries at times (we term this 'investor sentiment'). A model with such 'irrational' behavior could also be thought of as a reduced form of a model with rational investors, but with imperfections like short investor horizons, agency costs, or incomplete contracts. For instance, Scharfstein and Stein (1990), Bikchandani, Hirshleifer, and Welch (1992), and Welch (1992) show that investors may rationally ignore their own information and follow the decisions of other investors. This could explain trend-chasing and fads for certain industries.[6] Institutional managers may have an incentive to 'window-dress' their year-end portfolios so as to preserve their jobs. This could lead to excessive prices being paid for 'glamour' stocks.[7]

To restrict our degrees of freedom we adapt a well known theoretical model proposed by De Long, Shleifer, Summers and Waldmann (DSSW) (1990) in a different context. Furthermore, because the number of correlations predicted are greater than the number of irrationalities assumed, the model is falsifiable. We then test the empirical predictions using data on firm-commitment initial public offerings between 1975 and 1987.

The empirical results indicate that common factors appear to partially explain all three phenomena. While some of the correlations we find are not particularly surprising in light of the previous research, the existence of common factors explaining both underpricing and long run underperformance or IPO volume is, to the best of our knowledge, new. While we can only guess

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[6] Grinblatt, Titman, and Wermers (1995) provide evidence of trend chasing (also termed 'momentum' investing) among institutional investors.

[7] We do not claim, however, that all such behavior is necessarily rational. Investors may irrationally extrapolate past growth into the future (see Sirri and Tufano (1998) and Lakonishok, Shleifer and Vishny (1994)) or they may sell certain investments because the nominal yield is too low.

as to why the market conditions we postulate vary over time, we believe that a contribution of this paper is to suggest a disciplined way of investigating potential irrationalities in the IPO market.

The remainder of the paper is organized as follows. In section 1, we adapt De Long, Shleifer, Summers and Waldmann (1990) to model the underwriter's pricing decision. We test the empirical implications in section 2. Section 3 discusses the results and evidence from research on analyst forecasts that supports our analysis. Section 4 concludes.

## 1. Theory

### 1.1. The model

We consider a world with 4 dates: 0, 1, 2 and 3. At date 0, an investment bank wants to sell 1 completely divisible share of stock in a firm which is going public. The investment bank is assumed to act entirely in the interests of the firm, so we assume away any agency costs between the two. The stock pays a risky liquidating dividend of $\omega+\varepsilon$ at date 3. The long term shock to dividends, $\varepsilon$, is realized at date 3, and is distributed normally with mean 0 and variance $\sigma_\varepsilon^2$. $\omega$ is a measure of the firm's short term prospects, and is distributed uniformly U[-W, W]. The sequence of events on the other dates is discussed shortly.

#### 1.1.1. Investors

We assume there are three types of investors: first, there are rational speculators who set their demand for the share so as to maximize date 3 wealth. These investors maximize a mean-variance utility function with unit coefficient of risk aversion. Second, there are passive investors whose demand depends on the difference between the price and their expectation of the intrinsic value of the shares v, so that at each date t, demand is given by $\gamma + \alpha/2(v - p_t)$ where $\alpha= 1/\sigma_\varepsilon^2$. We term the price insensitive portion of their demand, $\gamma$, *investor sentiment*. Finally, trend chasers have demand proportional to past price movements, with factor of proportionality $\theta$, which we term *feedback risk*. At date t, their demand is given by $\theta(p_{t-1} - p_{t-2})$.[8]

### 1.1.2. Information and Sequence of Events

Not all investors are in the market at all times. At date 0, the investment bank sets a price of $p_0$ at which it will offer the share to passive investors who have expressed their intent to purchase. At date 1, the issue opens on the market and the entire supply of 1 share hits the market. At this date, rational speculators trade with passive investors and the investment bank in determining the market price. We also assume that rational speculators know the realization $\omega$ at this date.[9] Clearly, the equilibrium market price, $p_1$, when the issue opens may be different from the offer price. At date 2, all investors (including the feedback traders) participate in the market. $\omega$ is publicly revealed and price $p_2$ obtains. Finally, $\varepsilon$ is revealed at date 3.

### 1.1.3. Investor demand

At date 2, rational speculators face uncertainty about $\varepsilon$. Their demand for the stock is given by

$$D_2^r = \frac{(\omega - p_2)}{2\ \sigma_\varepsilon^2} = \frac{\alpha}{2}(\omega - p_2) \tag{1}$$

where $\alpha = 1/\sigma_\varepsilon^2$. Passive investors demand $\gamma + \alpha/2(\omega - p_2)$. Trend chasers will demand $\theta(p_1 - p_0)$. As in DSSW, we impose a stability restriction that

$$\alpha > \theta \tag{2}$$

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[8] We do not take a stand on who these investors are. A possible interpretation is that passive investors are institutions like mutual funds and pension funds, rational speculators are hedge funds and trend chasers are small investors.

[9] This does not necessarily imply that rational speculators have superior information about the firm. Instead of being a component of the final dividend, $\omega$ could be information about date-2 market conditions.

At date 1, positive feedback traders have not had the opportunity to see price movements and do not trade (in other words, they trade only after the open).[10] The only demand is from speculators and passive investors. Finally, at date 0, passive investors demand $D_0^P = \gamma - \alpha/2\, p_0$.

### 1.1.4. The Investment Bank's Objective

The investment bank wants to maximize the proceeds it gets from selling the share. For simplicity, we assume that the underwriter sells the share at the minimum of the offer price $p_0$ and the market price $p_1$.[11] The expected proceeds are:

$$\begin{array}{lll} p_0 & \text{if} & p_1 \geq p_0 \\ p_1 & \text{if} & p_1 < p_0. \end{array} \qquad (3)$$

This is tantamount to the investment bank having sold a call option on the shares. But interestingly, it controls the price movement of the underlying asset when it sets the exercise price $p_0$. The object of the exercise that follows is to determine the price $p_0$ the investment bank sets so as to maximize expected proceeds.

## 1.2. Equilibrium

Equating supply and demand at date 2,

$$1 = \gamma + \alpha/2\, (\omega - p_2) + \alpha/2\, (\omega - p_2) + \theta(p_1 - p_0) \qquad (4)$$

[10] Thus positive feedback investors see the underpricing/overpricing of the stock and then formulate their demand. The sequence of events is similar to Welch's theory of cascades where initial purchases by some investors draw in many others.

[11] Nothing depends on this assumption, though it simplifies the algebra. In practice, the price $p_0$ is the maximum price that the bank is legally allowed to sell shares at. If all the shares are not sold at date 0, then the investment bank sells the remaining shares at time 1, at the minimum of $p_0$ and the time 1 price, $p_1$. One way of thinking about our assumption is that the underwriter has to stabilize the issue at the offer price (see Hanley et al. (1993)). It thus buys back stock it has pre-sold to investors at the offer price even though the market price may be lower. However, it does not buy back stock which investors have bought from other investors at the market.

Also, because rational speculators face no residual uncertainty between date 1 and date 2, they must drive the prices at both dates to equal each other. Setting $p_1 = p_2$ in (4), we get

$$p_1 = -\frac{(1-\gamma)}{\alpha - \theta} - \frac{\theta}{\alpha - \theta} p_0 + \frac{\alpha}{\alpha - \theta}\omega \tag{5}$$

Note that the lower the price $p_0$, the higher the price $p_1$. This is because rational speculators rationally anticipate the date 2 demand of trend-chasers and bid up the date 1 price if the offer price is low. Now it is easy to derive the expected proceeds at date 0.

$p_1 \geq p_0$ if

$$\omega \geq p_0 + \frac{1-\gamma}{\alpha} = \overline{w} \tag{6}$$

Thus the expected proceeds are

$$\frac{1}{2W}\int_{-W}^{\overline{W}} p_1 dw + \frac{1}{2W}\int_{\overline{W}}^{W} p_0 dw \tag{7}$$

On expanding and substituting from (6) and (5), this works out to

$$p_0^2 \frac{-\alpha}{4W(\alpha - \theta)} + p_0\left(\frac{1}{2} - \frac{2(1-\gamma)\alpha - 2\theta W\alpha}{4W\alpha(\alpha - \theta)}\right) - \frac{(1-\gamma)^2}{4W\alpha(\alpha-\theta)} - \frac{2(1-\gamma)+\alpha W}{4(\alpha - \theta)} \tag{8}$$

The offer price $p_0$ that maximizes expected proceeds is then

$$p_0^* = W - 2\frac{\theta W}{\alpha} - \frac{(1-\gamma)}{\alpha} \tag{9}$$

Therefore, on average there is an observed run up in the price at the open if

$$E_0(p_1) - p_0^* = \left(\frac{\theta}{\alpha - \theta} - 1\right)W > 0 \tag{10}$$

That is, if

$$\theta > \alpha/2 \tag{11}$$

What is usually reported in empirical studies is the *underpricing* which is the run up in price normalized by the offer price. The expected underpricing is

$$\frac{(2\theta - \alpha)W}{(\alpha - \theta)\left(W - \frac{2\theta W}{\alpha} - \frac{1-\gamma}{\alpha}\right)} \tag{12}$$

The following is immediate:

***Result 1:*** *Underpricing is observed, on average, if θ > α/2. The expected underpricing increases in the feedback risk θ and decreases in the investor sentiment γ.*

The intuition is simple. If the offer price is high relative to the intrinsic value, passive investors are not likely to demand much. In anticipation of selling by trend-chasers, rational speculators will sell at date 1 unless their private information, ω, is particularly good. The underwriter will then have to offer the share at a much lower price. As the underwriter is limited on the upside by the offer price but has to bear all the cost of a fall in price, it buys insurance against feedback risk, θ, by underpricing. Clearly, the need to buy this insurance decreases if investor sentiment will keep the price high anyway, so underpricing decreases in γ.

Expanding (7) and substituting from (5), we obtain the expected revenue in terms of the offer price $p_0^*$. Then using the envelope theorem,

d Revenue($p_0^*$,θ,γ)/dθ = δ Revenue($p_0^*$,θ,γ)/δθ =

$$\frac{\overline{W} + W}{(\alpha - \theta)^2}\left(-\frac{(1-\gamma)}{2} - \frac{\alpha p_0^*}{2} - \frac{W\alpha}{2}\right) < 0 \tag{13}$$

Similarly, it can be shown that d Revenue($p_0^*$,θ,γ)/dγ >0.

***Result 2:*** *The expected proceeds from the initial public offering decrease in feedback risk and increase in the extent of investor sentiment.*

Our model also throws light on the relation between long term performance, market sentiment and feedback risk. From simple algebra we get the difference between the realized value at date 1, ω, and the price $p_1$ is

$$\frac{(1-\gamma)}{\alpha} + \frac{\theta}{(\alpha - \theta)}\left(W - \frac{2\theta W}{\alpha}\right) - \frac{\theta}{\alpha - \theta}\omega \tag{14}$$

The expected long term return to a particular stock (as measured from the opening market price) consists of three terms. The first term arises from investor sentiment which imparts an optimistic bias to the offer price and a negative bias to long term returns. The second term stems from the effect of deliberate underpricing on feedback trading. If issues, in general, are underpriced ($\theta > \alpha/2$), this term contributes negatively to long term returns. Finally, the third term represents the destabilizing effect of speculators who anticipate overreaction by feedback traders. Taking expectations over ω, and differentiating we see that

***Result 3:*** *The expected long run return increases in feedback risk if $\theta < k$ and decreases in feedback risk if $\theta > k$, where $\alpha(\sqrt{2}-1)/\sqrt{2} = 0.29\ \alpha$. Expected long run returns decrease in investor sentiment $\gamma$.*

While the effect of sentiment on long run returns is clear, the effect of feedback risk is a little more subtle. When feedback risk is low, the optimally set offer price tends to be higher than intrinsic worth. Because there are few feedback traders who will sell short, the opening price is not much different from the offer price, and long run performance is poor as the price declines to the intrinsic worth. But as feedback risk increases, long term returns improve at first. This is because even though the offer price continues to be set higher than intrinsic worth, the opening price is lower (than when feedback risk is smaller) because speculators dump stock in anticipation of later feedback selling. Thus long run returns improve. Eventually, of course, feedback risk increases to the point where the offer price is quite low relative to intrinsic worth. Now feedback traders are expected to go long in the stock, so that feedback risk pushes the average opening price above the intrinsic worth of the stock. Thus expected long run returns start falling with feedback risk. Note finally that if underpricing is observed on average so that $\theta > \alpha/2$, long run returns should always decrease with θ.

Finally, we can make some predictions about the volume of trading at date-2. Note first that passive investors will not trade at date 2 because they get no new information nor does the price change. All trading at date 2 is between the speculators and the feedback traders who enter the market. Therefore, the expected volume of trading is exactly equal to the expected absolute value of feedback trader demand which is

$$\theta E \ [abs \ (p_1 - p_0)] = \theta \ E \left[ \ abs \left( \frac{-\alpha W}{\alpha - \theta} + \frac{2\theta W}{\alpha - \theta} + \frac{\alpha\omega}{\alpha - \theta} \right) \right]$$

$$= \left( \frac{-\alpha W}{\alpha - \theta} + \frac{2\theta W}{\alpha\theta} \right) \quad \text{if} \quad \theta > \alpha/2$$

Therefore, if underpricing is observed on average so that $\theta > \alpha/2$, then

***Result 4:*** *The expected trading volume at date 2 increases with feedback risk θ.*

## 2. Data and Empirical Tests

The sample consists of all firm commitment[12] initial public offerings between 1975 and the second quarter of 1987 in the databases compiled by Ritter (see Ritter (1984,1991)), Loughran and Ritter (1995) and Barry, Muscarella and Vetsuypens (see their 1991 paper).[13] In addition, we obtain accounting data from Compustat and stock prices and trading volume from CRSP.

Table 1 clearly demonstrates two well-known 'anomalies' associated with initial public

[12] In a firm commitment offering, the investment bank purchases the entire issue from the firm. In a best efforts contract, the investment bank makes its best effort to sell the issue but has no obligation to do so.

[13] A number of criteria were used to exclude IPOs in these samples; combination offerings in which a 'unit' composed of both shares and warrants were offered, closed end mutual funds, real estate investment trusts (excluded only by Ritter) and conversions of mutuals to stock (Barry et al.) Ritter collected his sample based on announcements in *Going Public: The IPO Reporter*, whereas Barry et al. collected their sample based on public announcements in the *Wall Street Journal* and the Dow Jones News Wire. Loughran and Ritter purchased listings of IPOs from IDD Information Services and Securities Data Company for the 1985-1990 period.

offerings: First, issues are underpriced on average - the price at the close of the first trading day exceeds the offer price by 10.03%. The underpricing (computed by subtracting the offer price from the first closing price and dividing by the offer price) varies over time, with an average of 29% in 1980 and -1% in 1975. The second 'anomaly' is that the number of issues coming to market varies considerably, with large numbers in 1981, 1983 and 1986. Table 2 demonstrates a third 'anomaly': initial public offerings underperform a number of plausible benchmarks. For instance, while the average return (exclusive of the first-day return) over a 3 year holding period for the IPOs in our sample is 22.7%, they underperform the smallest NYSE/AMEX size decile portfolio by 10.4%.[14] We also matched each IPO with a seasoned NYSE, AMEX or NASDAQ firm in the same industry (defined at the two digit S.I.C. level) with the closest possible size.[15] Again the IPOs underperform, on average by 20.3%. Finally, it should be noted that the underperformance is largely concentrated in the latter years of the sample, especially in the 1980s.

### 2.1. Empirical Predictions

Given the simplicity of the model, we can only have confidence about the predictions of the

[14] Returns of firms that are delisted within three years of their IPO are counted until delisting.

[15] Each year we rank all stocks belonging to a 2-digit S.I.C. industry that have been listed on the CRSP NYSE/AMEX/NASDAQ database for at least three years by their market value of equity. For each IPO that takes place during the following year, we find the seasoned firm in the same industry with the closest market value of equity at the end of the previous year. If the matching firm is delisted when the IPO firm is still trading, we substitute another matching firm, chosen according to the same procedure, on the day after delisting of the original matching firm. This is similar to the procedure followed by Ritter (1991).

signs of correlations rather than the magnitude of any effects (though we can check if the effect is economically important). We know from Table 1 that stocks have been underpriced on average in every year after 1975. This suggests that $\theta > \alpha/2$. The empirical predictions that follow from this are:

(i) The extent to which a stock is underpriced is positively related to feedback risk $\theta$ and negatively related to the investor sentiment $\gamma$.

(ii) The long term excess returns measured from the open should be negatively related to $\theta$ and to $\gamma$.

(iii) The volume of trading on the second day after the issue should be positively related to the amount of feedback risk $\theta$.[16]

(iv) Because firms would want to tap markets so as to maximize expected proceeds, the number of firms coming to market should vary positively with factors enhancing the expected revenue. So the number of firms coming to market in a certain period should be negatively related to $\theta$ and positively related to $\gamma$.

## 2.2. Proxies for Market Conditions

Because there is little previous work on this subject, the proxies that we use for investor sentiment and feedback risk are bound to be subjective. However, we will attempt to convince the reader that our proxies are reasonable.

We have interpreted sentiment as the price-inelastic portion of demand for specific securities. More specifically, investors may be overoptimistic about particular industries - oil and

[16] Clearly, there is no reason why the dates in the model have to correspond to actual trading dates. An example of what we have in mind is that feedback traders are individual investors who read about the price run up in the newspapers the day after the issue opens and place their orders subsequently. The turnover on the first day is contaminated by speculative traders taking positions and passive investors 'flipping' their stock. However, the third day could also do. Eventually, all the feedback traders will have traded so that trading volume will reach its long run equilibrium and there will be no feedback component. This is why we think that turnover on the second day corresponds best with turnover on date 2 of the model.

gas companies in the early 1980s, computer and biotechnology companies in the late 1980s, casino stocks in the early 1990s, and technology and internet stocks in the late 1990s and early 2000. If so, the willingness to pay historically high prices (relative to book value or earnings) for seasoned firms in that industry may proxy for sentiment for an IPO in that industry. We therefore calculate two measures of sentiment.

Our first measure is the relative market to book for the industry at the time of the IPO. This is calculated as follows: we compute an equally weighted cross-sectional average of the market to book value of equity in the quarter before the IPO for all Compustat firms which have been in existence for at least 3 years, and are in the same 2-digit S.I.C. industry as the IPO.[17] We then divide this number by the market to book ratio averaged for all seasoned firms on Compustat to obtain RELMBK. We thus obtain a measure of whether the market is willing to pay high multiples for firms in that industry, relative to all firms in the market. Unlike Loughran and Ritter (1995) or Lakonishok, Shleifer and Vishny (1994), we do not use the market to book for the specific firm being brought to market, because that is endogenous in our model.[18]

As our second measure, we compute HISTMBK which is a measure of whether the industry is trading at historically high multiples. This is calculated as follows: we compute an equally weighted cross-sectional average of the market to book value of equity in the quarter before the IPO for all Compustat firms which have been in existence for at least 3 years, and are in the same 2-digit S.I.C. industry as the IPO. We divide this by the same measure averaged over all quarters in

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[17] We use S.I.C. codes provided by Compustat. A potential problem here is that Compustat determines the most likely S.I.C. based on the firm's business in the most recent year of existence. However, there is no reason to believe that this would systematically bias our results.

[18] Clearly, investors may be faddish about other aspects of an IPO than the industry the firm belongs to. For instance, interest in small firms (as well as expectations of their growth) may increase, leading investors to pay higher prices for small firm earnings relative to the price they are willing to pay for large firm earnings. If investors are increasingly attracted by the small size of the IPOs, then our equally weighted industry measure will partially reflect this increase.

the 5 years surrounding the IPO. HISTMBK will be highest when the industry is trading at high prices relative to its normal levels. In a sense, RELMBK captures the cross-sectional aspects of sentiment while HISTMBK captures the time series aspects.[19]

A direct proxy for feedback risk is the turnover (the volume of trading divided by the number of shares issued) on the second day.[20] Clearly, the turnover may be affected by a number of factors other than feedback risk. For example, it is possible that trading volume is associated with the price change on the first day of trading. Thus, an appropriate measure of feedback risk is the residual from a regression of turnover on these factors.

We compute our measure of feedback risk THETA as follows. We regress the second day turnover on a measure of size -- the log of the dollar volume of the offering (measured at the offer)--, a measure of risk -- the standard deviation of the stock's returns computed over the 100 day window starting the day after the IPO--, measures of price volatility -- the absolute price movement from the offer to the open (normalized by the offer) and its square --, the measures of sentiment RELMBK and HISTMBK defined above, and indicator variables for the industry the firm is in. There is no reason to expect the coefficient estimates to be stable so we compute different estimates for three different time periods: 1975-1979, 1980-84, 1985-87.[21] We define the feedback risk THETA for an IPO coming to market in January 1978 as follows. We estimate the model

$$\text{Second Day Turnover} = \alpha + \beta\,[\text{Explanatory Variables}] + \varepsilon$$

[19] Lowry (2002) employs the discount on closed-end funds as a measure of investor sentiment.

[20] In an earlier version of this paper, we used the cross-sectional variance of underpricing to proxy for feedback risk. The problem with that measure is that it cannot be computed for periods with very few IPOs and it may reflect the variety of firms coming to market rather than market conditions.

[21] We also computed feedback risk as the median prediction errors for IPOs coming to market in that month where the estimation was performed over the five years prior to the IPO. The results are qualitatively similar. We also reduced the window of estimation to three years and obtain similar results.

using all IPOs between 1975 and 1979 (except for those in the month of January 1978). We find the median prediction error using the estimated model for all IPOs coming to market in January 1978. This is our measure of feedback risk θ for all firms coming to market in January 1978.

### 2.3. The Effect of Market Conditions on Underpricing

According to our theory, underpricing should be positively correlated with feedback risk and it should be negatively correlated with investor sentiment. Also, past work (see Ritter (1984)) has shown that the degree of underpricing is related to the size of the firm going public. We proxy for size with the log of the dollar value of equity outstanding. In addition, Ritter identifies a number of variables that proxy for risk including the aftermarket standard deviation of the stock's returns, the number of uses listed in the prospectus, and the number of risk factors listed in the prospectus.[22]

Table 3A reports summary statistics for the above variables and table 3B reports correlations for some of these variables. In Table 4 column (i), the dependent variable is the realized underpricing while the explanatory variables are feedback risk, the measures of sentiment, and the aftermarket standard deviation of the stock's return. We exclude penny stocks from this analysis because they are associated with extreme levels of underpricing. Underpricing is positively related to feedback risk (β = 2.62, t-statistic = 7.78). The economic magnitude of this relationship is also significant. A one standard deviation increase in feedback risk increases underpricing by 15.7% of its standard deviation. Consistent with previous research, we also find a positive relation between underpricing and the aftermarket standard deviation of stock returns.

The results on sentiment are not consistent with our predictions. Our model predicts a

[22] We compute the standard deviation of stock returns over the 100 day window starting the day after the IPO. The other variables are only available for the firms included in Ritter's original database.

negative coefficient for both the time series component, HISTMBK, and the cross-sectional component, RELMBK, but both coefficients are not significantly different from zero.

In Table 4 column (ii) we add the log of firm equity size to the model as an additional explanatory variable. Firm size also proxies information asymmetry and risk. As the extent of underpricing increases in the amount of information asymmetry and risk, we should find underpricing negatively related to size. This is indeed the case. In column (iii), we also include Ritter's measures of risk: USES, RISKS and UNCER (though we drop STD which is similar to UNCER). We lose a lot of our observations (we have these measures only for Ritter's dataset) so these results must be interpreted with caution. There is a small decline in the coefficient on the feedback proxy, but it remains highly significant. The coefficient on RELMBK now becomes negative, as predicted by the model, but it is not significant at traditional levels. Contrary to our predictions, however, the coefficient on HISTMBK is now positive and significant. Nevertheless, the economic effect of sentiment on underpricing is small. A one standard deviation increase in both sentiment measures increases underpricing by less than 4% of its standard deviation.[23] [24]

### 2.4. The Effect of Market Conditions on Long Term Performance

The model predicts that the excess long term return on an IPO, as measured from the opening price $p_1$, should be negatively related to sentiment. Sentiment or overoptimism drives price above fundamentals. When prices revert to fundamentals in the long run, returns are more negative for issues that came to market during periods when sentiment was high. Our model also

[23] The small effect of sentiment on underpricing relative to the effect of feedback risk may not be entirely unexpected from the theory. Unlike feedback risk, sentiment does not affect the price movement at the open but does affect the offer price. Because we define underpricing as the price movement at the open normalized by the much larger offer price, we would expect factors affecting the numerator to have larger effect than factors affecting the denominator.

[24] Adding penny stocks to the regression has no qualitative effect on the coefficients for sentiment and feedback risk.

predicts that if feedback risk is high enough so that issues are underpriced, long term excess returns should decrease in feedback risk.

To test these predictions, we first determine the three-year returns for each IPO net of a benchmark. We use the three different benchmarks discussed earlier; the returns on the NYSE/AMEX value weighted index, the returns on the NYSE/AMEX smallest decile and the returns of a seasoned firm from the same industry as the IPO and with the closest market capitalization to it. We then regress these excess returns on our measures of feedback risk and sentiment. Note that it is hardly surprising that the time series measure of sentiment which includes the future realized market to book for the industry will be negatively correlated with long run returns. Therefore, we do not include this measure as an explanatory variable in the regression. The estimates are reported in Table 5A.

Because long term excess returns are notoriously volatile, it is not surprising that the explanatory power of these regressions is small. The sign of the sentiment and feedback coefficients are the expected ones for all three benchmarks and 5 out of 6 are significant at least at the 5% level. We also include the following measures of business conditions (see Fama and French (1989), Choe, Masulis and Nanda (1993)): the dividend yield at the time of issue, the default spread (the difference between yields on Baa bonds and Aaa bonds) at the time of issue and the term spread (the difference between yields on 10 year Treasury bonds and Treasury bills) at the time of issue. We do this to check if general business conditions drive the poor IPO excess returns. While the explanatory power of the regressions goes up moderately (R-squared of 0.015 when the dependent variable is NYSE/AMEX adjusted returns, 0.057 for smallest decile adjusted returns, 0.011 for matched firm adjusted returns), the coefficients on sentiment and feedback risk continue to be highly significant in 5 out of 6 cases (regressions are not reported). They always have the expected sign. A similar result obtains when the market to book ratio for the market at the time of the issue is included in the regression models.

The noise in returns can be reduced by forming portfolios. We group the IPOs into 64 portfolios on the basis of the sentiment (RELMBK), feedback risk, and the size quartile the IPO falls in. We include size because size is a predictor of realized returns. We then regress the median return on each portfolio on the median sentiment, feedback risk and size measure for the IPOs in that portfolio. These regressions are reported in Table 5B. As expected, the explanatory power of these portfolio regressions is much higher than the regression on individual IPOs. The long term excess returns decrease with sentiment (at the 1% level and independent of the benchmark), decrease with feedback risk (but statistically significant only in the regression explaining NYSE/Amex smallest decile adjusted returns), and increase with the size of the firm. Note that the size of these coefficients does not change much, even after we form portfolios and include our measure of size. The economic importance of these effects can be gauged from the following numbers. Despite the fact that feedback risk is not always significant in the portfolio regressions, it is economically important. In Table 5B, a one standard deviation increase in feedback risk for a portfolio reduces its NYSE/Amex adjusted long run returns by 14% of its standard deviation. The corresponding numbers for NYSE/Amex smallest decile adjusted returns is 20% and for matched firm adjusted returns it is 15%. The effect of sentiment is even larger. A one standard deviation increase in RELMBK reduces NYSE/Amex adjusted long run returns by 40%, NYSE/Amex smallest decile adjusted returns by 42%, and matched firm adjusted returns by 33% of their corresponding standard deviations. It is also useful to compare these effects to the effect that size has. A one standard deviation increase in feedback risk has about 40% of the effect that a standard deviation increase in log size has, while sentiment has about the same effect as size, on long run returns.

Note that sentiment is important even when returns are adjusted by returns on matched firms within the same industry. This suggests that sentiment for an industry may have a special influence on the price of IPOs, over and above its influence on the price of seasoned firms. Finally, the coefficient on size may simply reflect the poor performance of small firms over the 1980s.

It is interesting to compare these findings with previous work. Seyhun (1992) performs a time series analysis, regressing the (monthly) average long run excess returns against average initial returns, the standard deviation of initial returns, the dollar volume of the issue and the number of initial offerings in the month. He concludes from evidence on inside trades around the IPO, that long term underperformance stems from investors paying too high a price at the offer. Also, he finds a weak positive relationship between long term excess returns and underpricing, whence he argues that long term underperformance is not due to overreaction by investors after the opening.

While our finding that sentiment can explain a large portion of the long term underperformance is consistent with his findings that investors overpay, the importance of feedback risk in our results suggests overreaction. (Note that by omitting the first day returns from our measure of long run underperformance, we do not introduce a mechanical relationship between underpricing and long run underperformance). One reason for why our results may differ from Seyhun's is that he treats underpricing as a primitive while it is endogenous in our model. For instance, underpricing in the model is negatively correlated with sentiment which in turn is negatively correlated with long run excess returns. So the positive correlation between underpricing and long run returns that Seyhun finds may simply be because underpricing is proxying for an omitted variable.

Loughran and Ritter (1995) argue that low long run returns may be explained by two factors: (i) IPOs come to market near market peaks; and (ii) IPO firms have high market to book ratios, which are associated with lower returns. Clearly, (i) can only explain the low raw returns, not the low excess or matched returns. As for (ii), we show in the next section that IPOs have high market to book ratios because they come to market when their industries have high market to book ratios. But as the matched firm excess returns show, IPOs still underperform relative to seasoned firms in the same industry (also see the evidence from analyst forecasts in section 3). Our analysis confirms the fact that relative market to book ratios can partly explain long term underperformance, although we measure market to book ratios at the industry level, not the firm level. This enables us to abstract from potentially priced risk factors such as financial distress, which may explain low market to book ratios at the individual firm level. In addition, we show that there is another factor - feedback trader risk - which is an important determinant of long term returns.

### 2.5. Market Conditions and Windows of Opportunity

Our model suggests that if their intent is to maximize proceeds from the issue, firm managers and investment bankers will bring IPOs to market when sentiment is high, and when feedback risk is small. Over 40% of our sample comes from initial public offerings in 5 high technology or sunrise industries, namely computer software, electrical and electronics devices, computer hardware, electronic measurement and testing equipment, and pharmaceuticals, chemicals and bio-technology. An additional 3% comes from the oil and natural gas industry. Table 6 shows the annual number of firms coming to market in the 13 industries with more than 50 IPOs in our sample. In the computer software industry there is a clustering of IPOs in 1983-84 and another in 1986. In oil and natural gas there is a clustering of issues in 1980-81. Such strong industry patterns in the IPOs coming to market suggest the ‘opening of a window of opportunity’. We examine below if our measures of sentiment and feedback risk can partially explain these windows.

The dependent variable in the regressions in Table 7C is the number of IPOs coming to market in a quarter in a 2 digit S.I.C. industry. We have observations for 50 quarters (from the first quarter of 1975 to the second quarter of 1987), and we restrict ourselves to industries which have, on average, at least one IPO per quarter. This leaves us with 13 2-digit S.I.C. industries. We pool the observations and, because the dependent variable is censored at zero, we use a one sided censored tobit model to estimate the coefficients. The explanatory variables in the regression are our measures of sentiment and feedback risk. The estimates are reported in Column 1 of Table 7C, with summary statistics and correlations in Table 7A and Table 7B.

The effect of an increase in sentiment is to significantly *increase* the number of initial public offerings coming to market. Keeping in mind that this is a censored regression and the marginal effects reported are for the latent variable rather than the actual dependent variable, a one standard deviation increase in sentiment (RELMBK) for an industry increases the number of IPOs from that industry in the quarter by 1.37, which is 31% of the standard deviation of the dependent variable. A one standard deviation increase in HISTMBK increases the number of IPOs from that industry in the quarter by 1.8, which is 41% of the standard deviation of the dependent variable. This is consistent with the predictions of the model.[25]

As predicted, the coefficient on feedback risk is negative but it is not significant at conventional levels. This relationship does not, however, appear to be spurious. When we estimate the coefficients on an industry by industry basis, 10 of the 13 coefficients are negative. It is possible, though, that the relationship is non-linear. When we include the square of feedback risk in the regression, the explanatory power of the model increases and the coefficients for feedback risk and squared feedback risk are significantly negative at the 1% level. A one standard deviation increase in feedback risk from 0 reduces the number of firms coming to market in a quarter in that industry by 45% of its standard deviation.[26]

The effect of sentiment on issues coming to market together with the results on long run under-performance of IPOs from the previous section, suggests that IPOs come to market when their industry is 'overvalued' relative to the rest of the market. Does this effect persist even when we correct for Ritter and Loughran's finding that IPOs come to market when the overall market

[25] Other recent papers on the relationship between industry market-to-book ratios and IPO activity are Pagano, Panetta, and Zingales (1998) and Lowry (2002).

[26] We also included 2-digit industry dummies in our regression models, without affecting the qualitative nature of our results.

peaks? To check this possibility, we include the equally weighted average of the market-to-book equity ratio for all seasoned firms in the market in the quarter before the IPO, divided by the same measure averaged over all quarters in the surrounding 5 years. The estimates are reported in column (iii) of Table 7C. The coefficients on the sentiment variables remain highly significant, suggesting that they have an independent influence on the number of IPOs coming to market, even after correcting for the level of the market. However, the economic magnitude of the market to book ratio for the market is larger than the effect of the sentiment variables. A one standard deviation change in the market's market to book increases the number of firms coming to market by 154% of its standard deviation. A one standard deviation change in both sentiment variables increases the number of firms coming to market by 55% of its standard deviation. Note, however, that the inclusion of the average market to book for the market raises the explanatory power of the regression, a finding consistent with Loughran and Ritter (1995).

Is RELMBK a proxy for the investment opportunities in the industry? To check this possibility, we include a measure of the growth in investments that take place in the industry in the year of the IPO and the two years following it.[27] For industry i in year t, we compute INVGROWTH as follows, where the summation is over all seasoned firms j in that industry:

$$\frac{1}{n_i}\sum_{\text{firms } j\in i}\frac{\dfrac{\text{investment}_{j,t}}{\text{sales}_{j,t}}+\dfrac{\text{investment}_{j,t+1}}{\text{sales}_{j,t+1}}+\dfrac{\text{investment}_{j,t+2}}{\text{sales}_{j,t+2}}}{\dfrac{\text{investment}_{j,t1}}{\text{sales}_{j,t1}}}$$

INVGROWTH and RELMBK are significantly positively correlated (ρ=0.20, T=5.8)). But the raw

[27] The quarterly Compustat data on investments is very sparse, so we are forced to use annual data.

correlation between INVGROWTH and the number of IPOs coming to market is an insignificant 0.06. Furthermore, the coefficient estimate for INVGROWTH (Table 7C, column (iv)) is negative and does not reduce the coefficient for the sentiment variables -- which suggests they are not measuring the same thing. We also compute INVGROWTH lagged 3 periods, which is a proxy for the past growth in the industry. The raw correlation between $INVGROWTH_{-3}$ and the number of IPOs coming to market is 0.14 which is significant at the 1% level. $INVGROWTH_{-3}$ is also more strongly correlated with RELMBK ($\rho$=0.27). When we include $INVGROWTH_{-3}$ in the regression, the coefficient is significant and positive (Table 7C, column (iv)). Therefore, the number of IPOs coming to market is significantly related to past investment growth in that industry, but not to future investment growth.

Finally, we include the dividend yield, the term spread and the default spread, which are measures of general business conditions proposed by Fama and French (1989) and Choe, Masulis and Nanda (1993). We included these variables with a dual purpose. First, if they proxy for time varying risk premia, as suggested in Fama and French, we will be able to establish the importance of our proxies after correcting for the nominal level of the stock market. Second, these variables may also proxy for the general level of investment opportunities that Choe, Nanda and Masulis find to be important. As shown in column (v) of Table 7C, the term spread and the default spread are significantly correlated with the number of firms coming to market. Interestingly, the coefficients of feedback risk and feedback risk squared remain negative and significant and the coefficients on our measures of investor sentiment remain positive and significant.

## 3. Discussion

We know from that returns are negatively correlated with a firm's market to book ratio (see Fama and French (1992) for references). Our measures of sentiment are based on the market to book ratio, but attempt to correct for the level of the market (in the cross-sectional measure) and for the historical level of the industry (in the time-series measure). While some readers may not finding it surprising that these adjusted measures are still negatively correlated with long run returns, the evidence that these measures are correlated with the volume of IPOs coming to the market is perhaps more novel. The finding that these measures are important even after we add the level of the market adds to the evidence in Loughran and Ritter (1995).

It is also well known that trading volume is correlated with price volatility [see Lo and Wang (2000) for references]. In deriving our measure for feedback risk, we attempt to correct for price volatility and other relevant factors (see section 2). Furthermore, our measure is market-wide rather than firm-specific. Still some readers may not find it surprising that our proxy labeled 'feedback risk' is positively correlated with firm specific initial price movements. Perhaps more interesting is that it also has some explanatory power for long run returns and the volume of IPOs coming to market. These correlations suggest that the phenomena may be related, which is something the previous literature has not focused on. We believe that more convincing tests of the phenomena we seek to understand can only come from more direct data. The most direct evidence of investors behavior would be from an analysis of who trades around IPOs and what their expectations are.

An alternative source of data, though still one step removed from actual investors, is analyst forecasts. Rajan and Servaes (1997) provide detailed evidence on the frequency and accuracy of analysts forecasts for IPOs. They find that analyst following increases with underpricing, after controlling for firm size.[28] These analysts then make overoptimistic earnings forecasts for the two

[28] Of course, this result suggests that there may be benefits to underpricing instead of simply costs. The promoter may find it advantageous to create a large initial price run-up in the stock, not simply to attract feedback traders but also to attract attention. Underpricing need not only signal quality (Welch (1989), Allen and Faulhaber (1989), Jegadeesh, Weinstein and Welch (1993)) so as to ease future equity issuances, but may make the issue a 'story stock' which could cause information producers like the media and analysts to examine the firm more closely, attract clients to the firm, and prestige to the owner (see Demers and Lewellen (2001)). In turn, this will boost the price of the promoter's remaining stock. This raises the possibility that the objective function we have specified for the promoter (the investment bank / firm) may be incorrect. Perhaps promoters care as much about the short term after-market price of the issue as they care about the proceeds

fiscal years after the IPO. Forecasts errors averages 2.4% of the stock price before making industry adjustments, and 1.8% of the stock price after making industry adjustments, where only seasoned firms (more than three years since their IPO) are used to construct the industry sample. This indicates that there is an IPO overoptimism effect and that this effect persists even after adjusting for industry overoptimism.

Rajan and Servaes (1997) also find that this overoptimism on the part of analysts is reflected in the behavior of the firm's stock price, which supports the notion that investors rely on analyst forecasts in making their decisions. The stocks with the worst aftermarket performance are those where analysts were most overoptimistic and vice-versa. [29]

Related evidence is also presented by Rao, Teoh, and Wong (1998) who find that the long-run underperformance of IPOs is related to earnings management by these companies. The companies with the most extensive use of discretionary accruals have the worst post-issue performance. If analysts do not fully incorporate the implications of these accrual policies into their earnings predictions, this could lead to the results described above.

Overall, these results on analyst following, together with our findings support the notion that there is systematic overoptimism in the IPO market, which contributes to the anomalies we are addressing.

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raised through the offering. Such a change to the objective function will weaken the negative relationship between the numbers coming to market and feedback risk.

[29]See also Michaely and Womack (1999) for an analysis of analyst recommendations in IPOs.

## 4. Conclusion

Much of what we have done is exploratory. There clearly is enormous scope for improvement -- in examining the robustness of the kinds of proxies used, in refining the institutional details of the model, in providing more detailed evidence (and perhaps more rational explanations) of this kind of irrational behavior, and in explaining why this behavior varies with time.

An important criticism of models of (seemingly) irrational behavior is that while they explain any and everything ex-post, they do not help predict behavior. Clearly, if we are allowed one irrationality per phenomenon, we can explain anything. In this paper we restrict our degrees of freedom, first, by adapting a well-known theoretical model developed in a different context, and second, by deriving over-identifying restrictions from the model. It appears that our proxies for feedback risk and investor sentiment have some power in explaining well-known anomalies associated with initial public offerings.

At the very minimum, a contribution of this paper is to call attention to the possibility that common factors explain both underpricing and long run underperformance/IPO volume. Some may choose to call our proxies for feedback and sentiment 'risks'. However, risk based explanations cannot, thus far, account for the relationships between the phenomena that we document. For instance, why should initial underpricing or IPO volume be influenced by systematic risks? But we also recognize important shortcomings of this paper; we cannot precisely identify why the market conditions we postulate vary over time, and we assume without any basis that the conditions are independent. Elucidation of these matters requires a much better understanding of the micro-foundations of investor behavior, and much better data on how the population of investors varies over time. In a sense, we have only pushed the puzzles associated with IPOs one step further. But our paper provides a systematic basis for thinking about IPO anomalies, and adds to the evidence (see Loughran and Ritter (1995) for example) that they do not necessarily have different explanations from other anomalies in the stock market.[30] There is obviously scope for further research.

[30] For instance, the importance of the market to book factor (Fama and French, 1992) alternatively termed the underperformance of 'glamour' stocks (Lakonishok, Shleifer, and Vishny, 1993), and the underperformance of seasoned equity issues (Loughran and Ritter (1995)).

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Table 1
Average underpricing and standard deviation of underpricing by year of going public.

Underpricing is computed as : (First Aftermarket Price - Offer Price) / Offer Price. Only firm commitment offers are included in the sample.

| Year | Average underpricing | Cross-sectional Standard Deviation of Underpricing | N |
|---|---|---|---|
| 75 | -0.0088 | 0.0432 | 11 |
| 76 | 0.0030 | 0.0846 | 28 |
| 77 | 0.0660 | 0.1543 | 20 |
| 78 | 0.1413 | 0.1890 | 24 |
| 79 | 0.1351 | 0.4070 | 49 |
| 80 | 0.2899 | 0.5555 | 125 |
| 81 | 0.1186 | 0.3439 | 320 |
| 82 | 0.1032 | 0.1867 | 107 |
| 83 | 0.1100 | 0.2575 | 651 |
| 84 | 0.0662 | 0.2015 | 336 |
| 85 | 0.0877 | 0.1466 | 276 |
| 86 | 0.0785 | 0.1719 | 551 |
| 87 (6 months) | 0.0677 | 0.1326 | 227 |
| | Average = 0.1003 | Average = 0.2557 | Total = 2725 |

Table 2
Average three year performance according to several benchmarks by year of going public.

Returns are computed for 756 trading days starting from the second trading day. The adjusted returns are computed by subtracting the 3-year return on NYSE/Amex (value weighted), the smallest decile of NYSE/Amex and a matched firm from the 3-year raw return. The firm closest in size (traded on NYSE, Amex or Nasdaq) to the IPO firm from the same 2-digit SIC industry is used as a matching firm if it has been listed for at least 3 years. If firms are delisted, returns are only computed until the delisting.

| Year | Raw return. | NYSE/Amex adjusted return | NYSE/Amex smallest decile adjusted return. | Matched Firm adjusted return |
|---|---|---|---|---|
| 75 | 0.5822 | 0.2913 | -0.5193 | -0.1041 |
| 76 | 0.9004 | 0.6871 | 0.0267 | 0.0478 |
| 77 | 1.9805 | 1.6065 | 0.9913 | 0.6026 |
| 78 | 1.2302 | 0.7628 | 0.5198 | 0.0025 |
| 79 | 0.4789 | 0.1236 | -0.1608 | -0.2467 |
| 80 | 0.4357 | 0.0122 | -0.8022 | -0.6156 |
| 81 | 0.1062 | -0.2373 | -0.8428 | -0.7446 |
| 82 | 0.3194 | -0.3552 | -0.6741 | -0.5624 |
| 83 | 0.1912 | -0.3088 | -0.0127 | -0.1779 |
| 84 | 0.6237 | -0.1483 | 0.2630 | 0.0724 |
| 85 | 0.1323 | -0.3852 | -0.0870 | -0.1170 |
| 86 | 0.0862 | -0.2858 | 0.0461 | -0.0365 |
| 87 (6 months) | -0.0336 | -0.3660 | 0.0742 | -0.1498 |
| | 0.2274 | -0.2243 | -0.1036 | -0.2033 |

Table 3A
Summary statistics

| Variable | N | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|
| Underpricing | 2725 | 0.1003 | 0.2557 | -0.625 | 4.0000 |
| LT rets NYSE/Amex adj. | 2505 | -0.2243 | 1.5031 | -2.14 | 36.55 |
| LT rets small firm adj. | 2505 | -0.1036 | 1.5309 | -3.23 | 37.07 |
| LT rets match. firm adj. | 2239 | -0.2033 | 1.9139 | -23.63 | 23.59 |
| Feedback risk | 2749 | -0.064 | 0.0112 | -0.0479 | 0.0721 |
| Relmbk | 2521 | 1.1802 | 0.3565 | 0.394 | 2.937 |
| Histmbk | 2520 | 1.0747 | 0.1368 | 0.686 | 1.576 |
| Lsizeeq | 2478 | 10.32 | 1.1385 | 4.723 | 14.899 |
| Std | 2487 | 0.0295 | 0.0131 | 0.0024 | 0.1240 |
| Uses | 1385 | 6.812 | 7.1770 | 0 | 30 |
| Risks | 786 | 44.29 | 29.60 | 0 | 98 |
| Uncer | 640 | 42.69 | 41.65 | 0 | 910 |

Computation end definition of variables:
Underpricing : (First aftermarket price - offer price) / offer price.
LT rets NYSE/Amex adj. : three year returns of the IPO firm (excluding the first day return) minus the value weighted NYSE/Amex returns.
LT rets small firm adj. : three year returns of the IPO firm (excluding the first day return) minus the returns of the smallest decile of stocks on the NYSE and Amex.
LT rets match. firm adj. : three year returns of the IPO firm (excluding the first day return) adjusted for the performance of a matching firm in the same industry (2-digit SIC) and closest in size.
Feedback risk : median abnormal turnover on the second trading day for all firms going public in the same month as the IPO firm.
Relmbk : Average equity market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the month prior to the IPO, divided by the equity market to book ratio for all seasoned firms in the market at the end of that month.
Histmbk : Average market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the month prior to the IPO, divided by the same measure averaged over all months in the 5 years surrounding the IPO.
Lsizeeq : Logarithm of the market value of the equity based on the offer price.
Std : standard deviation of stock returns computed over the 100-day window starting on the second day of trading.
Uses : Number of uses of proceeds listed in the prospectus (only available for IPOs in Ritter's 1975-1984 database).
Risks : Number of risk factors listed in prospectus (only available for IPOs in Ritter's 1975-1984 database).
Uncer : Aftermarket return standard deviation for the first 20 trading days, as a percentage (only available for IPOs in Ritter's 1975-1984 database).

Table 3B
Correlation Matrix for Selected Variables

| | Underpr. | Feedback risk | Relmbk | Histmbk | Lsizeeq | Std | Uses | Risks |
|---|---|---|---|---|---|---|---|---|
| Feedback risk | 0.1589 | | | | | | | |
| Relmbk | 0.0570 | 0.0385 | | | | | | |
| Histmbk | 0.0429 | 0.0001 | 0.3547 | | | | | |
| Lisizeeq | -0.0743 | -0.0174 | 0.0075 | 0.0752 | | | | |
| Std | 0.1592 | -0.0022 | 0.1464 | 0.0523 | -0.0679 | | | |
| Uses | 0.2796 | -0.0223 | 0.1490 | 0.1237 | -0.5679 | 05647 | | |
| Risks | 0.0207 | 0.0233 | -0.0286 | -0.0138 | -0.1036 | 0.0751 | 0.0026 | |
| Uncer | 0.1550 | 0.0453 | 0.0504 | -0.0002 | -0.1684 | 0.3162 | 0.2554 | -0.0314 |

All variables have been defined in table 3A.

Table 4
Cross-sectional regression of underpricing on measures of feedback trading.

The dependent variable, underpricing, is computed as: (First aftermarket price - Offer price) / Offer price). FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same month as the IPO firm. RELMBK is the average equity market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the month prior to the IPO, divided by the market to book ratio for all seasoned firms in the market at the end of that month. HISTMBK is the average market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the month prior to the IPO, divided by the same measure averaged over all months in the 5 years surrounding the IPO. Industry is defined at the 2 digit SIC code level. STD is the standard deviation of stock returns computed over the 100 day window starting the 2nd trading day. LOG EQUITY is the logarithm of the market value of the equity based on the offer price. USES is the number of uses of the proceeds listed in the prospectus. RISKS is the number of risk factors listed in the prospectus. UNCER is the aftermarket return standard deviation for the first 20 trading days, expressed as a percentage. Penny stocks (offer price < $1) are excluded from the analysis. Standard errors are in parentheses.

Regression model: UNDERPRICING = a + $b_1$ FEEDBACK RISK + $b_2$ RELMBK + $b_3$ HISTMBK + $b_4$ STD + $b_5$ LOG EQUITY + $b_6$ USES + $b_7$ RISKS + $b_8$ UNCER

| | (i) | (ii) | (ii) |
|---|---|---|---|
| INTERCEPT | -0.0205<br>(0.032) | 0.0800 *<br>(0.047) | -0.1335<br>(0.121) |
| FEEDBACK RISK | 2.6203 ***<br>(0.337) | 2.6016 ***<br>(0.340) | 2.1511 ***<br>(0.797) |
| RELMBK | 0.0087<br>(0.012) | 0.0096<br>(0.013) | -0.0302<br>(0.022) |
| HISTMBK | 0.0371<br>(0.030) | 0.0455<br>(0.030) | 0.1448 **<br>(0.064) |
| STD | 2.3716 ***<br>(0.317) | 2.2644 ***<br>(0.320) | |
| LOG EQUITY | | -0.0103 ***<br>(0.003) | 0.0110<br>(0.010) |
| USES | | | 0.0031 *<br>(0.002) |
| RISKS | | | 0.0001<br>(0.0003) |
| UNCER | | | 0.0001<br>(0.0002) |
| Adj. $R^2$ | 0.0529 | 0.0552 | 0.0279 |
| N | 2158 | 2134 | 459 |

*** significant at the 1% level ** significant at the 5% level * significant at 10% level

Table 5A
Cross-sectional regression of long term returns on measures of feedback trading and investor sentiment.

NYSE/Amex adjusted returns are computed as: raw 756 trading day return for IPO firm - return on CRSP value weighted NYSE/Amex index over the same period. NYSE/Amex smallest decile adjusted returns are computed as: Raw 756 trading day return for the IPO firm - return on smallest decile of NYSE/Amex firms over the same period. Matching firm adjusted returns are computed as: raw 756 trading day return for the IPO firm - return on the seasoned firm (listed at least 3 years) in the industry which is closest in size. Industry is defined at the 2 digit SIC code level. FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same month as the IPO firm. RELMBK is the average market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the quarter prior to the IPO, divided by the market to book ratio for all seasoned firms in the market at the end of that quarter.

Regression model: LONG TERM RETURNS = a + $b_1$ FEEDBACK RISK + $b_2$ RELMBK

| | NYSE/Amex adjusted | NYSE/Amex smallest decile adjusted | Matching firm adjusted |
|---|---|---|---|
| INTERCEPT | 0.2571 ** (0.1164) | 0.6800 *** (0.117) | 0.2016 (0.145) |
| FEEDBACK RISK | -7.026 ** (2.877) | -9.9240 *** (2.905) | -4.8821 (3.611) |
| RELMBK | -0.4365 *** (0.094) | -0.7246 *** (0.095) | -0.3639 *** (0.117) |
| Adjusted $R^2$ | 0.0116 | 0.0302 | 0.0045 |
| N | 2275 | 2275 | 2199 |

Table 5B
Cross-sectional regression of long term returns on measures of investor sentiment and feedback trading for 64 portfolios.

NYSE/Amex adjusted returns are computed as: raw 756 trading day return for IPO firm - return on CRSP NYSE/Amex index over the same period. NYSE/Amex smallest decile adjusted returns are computed as: Raw 756 trading day return for the IPO firm - return on smallest decile of NYSE/Amex firms over the same period. Matching firm adjusted returns are computed as: raw 756 trading day return for the IPO firm - return on the seasoned firm (listed at least 3 years) in the industry which is closest in size. Industry is defined at the 2 digit SIC code level. FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same month as the IPO firm. RELMBK is the average market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the quarter prior to the IPO, divided by the market to book ratio for all seasoned firms in the market at the end of that quarter. Firms are divided into 64 portfolio according to quartiles of FEEDBACK RISK, RELMBK and LOG SIZE EQUITY. These regressions use the portfolio medians of these 3 variables as explanatory variables. Standard errors are in parentheses.

Regression model: LONG TERM PORTFOLIO RETURNS = a + $b_1$ FEEDBACK RISK + $b_2$ RELMBK + $b_3$ LOG SIZE EQUITY

| | NYSE/Amex adjusted | NYSE/Amex smallest decile adjusted | Matching firm adjusted |
|---|---|---|---|
| INTERCEPT | -1.4130 *** (0.342) | -1.5503 *** (0.384) | -0.9788 ** (0.387) |
| FEEDBACK RISK | -4.2758 (3.121) | -7.341 ** (3.507) | -4.6561 (3.534) |
| RELMBK | -0.5634 *** (0.125) | -0.6455 *** (0.141) | -0.4019 *** (0.142) |
| LOG SIZE EQUITY | 0.1456 *** (0.0302) | 0.1830 *** (0.034) | 0.1220 *** (0.0342) |
| $R^2$ | 0.4065 | 0.4545 | 0.2400 |
| N | 64 | 64 | 64 |

*** significant at the 1% level
** significant at the 5% level
* significant at 10% level

Table 6
Number of IPOs by year for industries with at least 50 IPOs in the sample

| | SIC | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13 | 28 | 35 | 36 | 38 | 48 | 50 | 58 | 60 | 61 | 67 | 73 | 80 |
| 1975 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1976 | 1 | 0 | 9 | 3 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 0 |
| 1977 | 1 | 1 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1978 | 0 | 1 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| 1979 | 9 | 2 | 8 | 7 | 8 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 2 |
| 1980 | 24 | 5 | 15 | 19 | 10 | 3 | 4 | 1 | 0 | 1 | 5 | 2 | 1 |
| 1981 | 49 | 14 | 32 | 45 | 35 | 5 | 9 | 10 | 0 | 0 | 2 | 38 | 7 |
| 1982 | 1 | 3 | 16 | 14 | 12 | 5 | 1 | 9 | 0 | 1 | 2 | 23 | 3 |
| 1983 | 1 | 37 | 69 | 65 | 62 | 13 | 24 | 29 | 18 | 50 | 16 | 102 | 34 |
| 1984 | 0 | 14 | 34 | 40 | 17 | 11 | 10 | 11 | 22 | 14 | 24 | 51 | 22 |
| 1985 | 2 | 8 | 17 | 17 | 14 | 8 | 8 | 7 | 22 | 13 | 24 | 22 | 11 |
| 1986 | 0 | 25 | 24 | 23 | 19 | 16 | 12 | 8 | 6 | 10 | 21 | 43 | 11 |
| 1987 | 0 | 9 | 14 | 10 | 14 | 3 | 7 | 5 | 1 | 2 | 5 | 16 | 5 |
| Total | 88 | 121 | 247 | 250 | 197 | 65 | 75 | 82 | 70 | 91 | 101 | 309 | 97 |

Industry definitions

SIC 13 = oil and gas extraction
SIC 28 = chemicals and allied products
SIC 35 = computer hardware and industrial machinery
SIC 36 = electronics and electrical equipment
SIC 38 = instruments and related products
SIC 48 = communications
SIC 50 = durable goods - wholesale

SIC 58 = eating and drinking places
SIC 60 = depository institutions
SIC 61 = nondepository credit institutions
SIC 67 = holding and other investment offices
SIC 73 = software and business services
SIC 80 = health services

Table 7A

Summary statistics and correlation coefficients for variables used in 'hot issue' tests.

NUMQ is the number of IPOs coming to market in a quarter in a (2 digit) industry. FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same quarter as the IPO firm. RELMBK is the average equity market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the previous quarter, divided by the market to book ratio for all seasoned firms in the market at the end of that quarter. HISTMBK is the average market to book ratio for all seasoned firms in the industry (listed at least 3 years) at the end of the quarter prior to the IPO, divided by the same measure averaged over all quarters in the 5 years surrounding that quarter. MARKETMBK is the equally weighted equity market to book ratio for all seasoned firms in the market in the previous quarter, divided by the same measure averaged over all quarters in the 5 years surrounding that quarter. INVGTH is the average over all seasoned firms in the industry of the three year sum of annual investment to sales ratios (i.e. the current year and the next two years) divided by the investment to sales ratio in the previous year. $INVGTH_{-3}$ is INVGTH lagged three years. Only observations for the 13 industries with an average of at least one IPO per quarter (i.e. at least 50 IPOs) are included. The investor sentiment and feedback trader measures are re-computed on a quarterly basis for this analysis.

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| NUMQ | 2.758 | 4.406 | 0 | 35 |
| FEEDBACK RISK | -0.0053 | 0.011 | -0.032 | 0.025 |
| RELMBK | 1.134 | 0.343 | 0.51 | 2.898 |
| HISTMBK | 1.002 | 0.134 | 0.637 | 1.480 |
| MARKETMBK | 1.004 | 0.988 | 0.767 | 1.198 |
| INVGTH | 3.799 | 0.593 | 2.47 | 6.038 |
| $INVGTH_{-3}$ | 3.821 | 0.583 | 2.495 | 5.608 |

Table 7B

Correlation coefficients for the variables used in the 'hot issue' tests

NUMQ is the number of IPOs coming to market in a quarter in a (2 digit) industry. FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same quarter as the IPO firm. RELMBK is the average equity market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the previous quarter, divided by the market to book ratio for all seasoned firms in the market at the end of that quarter. HISTMBK is the average market to book ratio for all seasoned firms in the industry (listed at least 3 years) at the end of the quarter prior to the IPO, divided by the same measure averaged over all quarters in the 5 years surrounding that quarter. MARKETMBK is the equally weighted equity market to book ratio for all seasoned firms in the market in the previous quarter, divided by the same measure averaged over all quarters in the 5 years surrounding that quarter. INVGTH is the average over all seasoned firms in the industry of the three year sum of annual investment to sales ratios (i.e. the current year and the next two years) divided by the investment to sales ratio in the previous year. $INVGTH_{-3}$ is INVGTH lagged three years. Only observations for the 13 industries with an average of at least one IPO per quarter (i.e. at least 50 IPOs) are included. The investor sentiment and feedback trader measures are re-computed on a quarterly basis for this analysis.

| | NUMQ | FEEDBACK RISK | RELMBK | HISTMBK | MARKETMBK | INVGTH |
|---|---|---|---|---|---|---|
| FEEDBACK RISK | -0.0016 | | | | | |
| RELMBK | 0.2265 | 0.0146 | | | | |
| HISTMBK | 0.3303 | 0.0198 | 0.2546 | | | |
| MARKETMBK | 0.2873 | 0.0105 | 0.0009 | 0.7669 | | |
| INVGTH | 0.0598 | 0.0826 | 0.1951 | 0.1933 | 0.1046 | |
| $INVGTH_{-3}$ | 0.1405 | -0.1044 | 0.2775 | -0.0768 | -0.0900 | -0.0429 |

Table 7C

Tobit regression of number of IPOs coming to market during a quarter

The dependent variable is the number of IPOs coming to market in a quarter in a (2-digit) industry. FEEDBACK RISK is measured as median abnormal turnover on the second trading day for all firms going public in the same quarter as the IPO firm. RELMBK is the average equity market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the previous quarter, divided by the market to book ratio for all seasoned firms in the market at the end of that quarter. HISTMBK is the average market to book ratio for seasoned firms in the industry (listed at least 3 years) at the end of the previous quarter, divided by the same measure averaged over all quarters in the 5 surrounding years. MARKETMBK is the equally weighted equity market to book ratio for all seasoned firms in the market in the previous quarter, divided by the same measure averaged over all quarters in the 5 years surrounding that quarter. INVGTH is the average over all seasoned firms in the industry of the three year sum of annual investment to sales ratios (i.e. the current year and the next two years) divided by the investment to sales ratio in the previous year. $INVGTH_{-3}$ is INVGTH lagged three years. DIVYLD is the S&P 500 dividend yield. TERMSPR is the difference between the yield on 10 year treasury bonds and treasury bills. DEFSPR is the difference between the yield on Baa and Aaa bonds. DIVYLD, TERMSPR and DEFSPR are obtained from Citibase. Only observations for the 13 industries with an average of at least one IPO per quarter (i.e. at least 50 IPOs) are included. The investor sentiment and feedback trader measures are re-computed on a quarterly basis for this analysis. Only the estimates from a pooled Tobit estimation are reported. The coefficient on the constant and industry dummies are not reported. Standard errors are in parentheses.

Table 7C (continued)

Regression model : NUMBER OF IPOs IN QUARTER q in INDUSTRY i = a + $b_1$ FEEDBACK RISK + $b_2$ FEEDBACK RISK SQUARED + $b_3$ $RELMBK_{i,q}$ + $b_4$ $HISTMBK_{i,q}$ + $b_5$ $MARKETMBK_q$ + $b_6$ $INVGTH_{i,q}$ + $b_7$ $INVGTH_{i,q-3}$ + $b_8$ DIVYLD + $b_9$ TERMSPR + $b_{10}$ DEFSPR

| Variable | (i) | (ii) | (iii) | (iv) | (v) |
|---|---|---|---|---|---|
| INTERCEPT | -17.08 *** (2.042) | -14.74 *** (2.024) | -18.83 *** (2.835) | -23.47 *** (3.644) | -28.58 *** (4.920) |
| FEEDBACK RISK | -15.14 (24.12) | -77.97*** (27.96) | -75.94 *** (27.83) | -66.96 *** (10.49) | -65.65 ** (28.42) |
| FEEDBACK RISK SQUARED | | -9439 *** (1754) | -9252 *** (1751) | -8360 *** (1751) | -8075 *** (1800) |
| RELMBK | 4.002 *** (0.786) | 3.948 *** (0.772) | 4.503 *** (0.815) | 3.281 *** (0.867) | 4.857 *** (0.808) |
| HISTMBK | 13.325 *** (2.000) | 12.095 *** (1.967) | 6.659 ** (3.256) | 8.335 ** (3.294) | 5.934 * (3.175) |
| MARKETMBK | | | 8.864 ** (4.259) | 7.763 * (4.242) | 14.624 *** (4.632) |
| INVGTH | | | | -0.0277 (0.456) | |
| $INVGTH_{-3}$ | | | | 1.4547 *** (0.484) | |
| DIVYLD | | | | | 0.1091 (0.413) |
| TERMSPR | | | | | 0.8005 *** (0.193) |
| DEFSPR | | | | | 1.5522 *** (0.552) |
| Pseudo $R^2$ | 0.0319 | 0.0433 | 0.0449 | 0.0460 | 0.0563 |
| N | 624 | 624 | 624 | 612 | 624 |

*** significant at the 1% level ** significant at the 5% level * significant at 10% level