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Australian IPO pricing in the short and long run

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Abstract

We analyse both initial underpricing and post-listing returns for Australian IPOs. Our results are consistent with the view that unique institutional characteristics may have overwhelmed previous Australian tests of equilibrium models of IPO underpricing. The results also show that Australian IPOs significantly underperform market movements in the three-year period subsequent to listing. Further investigation of these anomalous post-listing returns lead us to reject various 'speculative bubble' explanations. Rather, the evidence suggests a curvilinear relationship between initial and subsequent returns, although the economic significance of the relationship is low.

JEL classification: G 14; G 24

Keywords: Initial public offers; Underpricing; Long-run returns; Anomalies

1. Introduction

Initial public offerings of shares (IPOs) are frequently issued at prices substantially less than the market price on the first day of listing. Such 'IPO underpricing' has been widely documented and appears internationally pervasive. [1] However, recent analytical models predict IPO underpricing as an equilibrium result within a rational expectations framework. Rock (1986), which is widely cited, argues that

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[1] Loughran et al. (1994) summarise international evidence of IPO underpricing, as well as potential determinants thereof.

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the majority of IPO investors (i.e., the uninformed [2]) face an information disadvantage relative to those acquiring costly information about the market value of the offering. Uninformed investors face a winners' curse. Rationing of IPO allocations, and the information disadvantage relative to informed investors, results in uninformed investors earning only a 'nominal' return. Direct evidence in support of Rock's model is provided by Koh and Walter (1989) and Keloharju (1993). However, the unavailability of data on allocation methods used in IPOs limits the extent of direct tests.

More recently, long-run return evidence for IPOs has been documented. Ritter (1991) shows that US IPOs significantly underperform in the three years subsequent to listing. Similar results are reported for IPOs in the United Kingdom (Levis, 1993) and Finland (Keloharju, 1993). [3] However, evidence of long-run returns for IPOs is less extensive (both temporally and internationally) than evidence of underpricing. Similarly, explanations for poor abnormal returns post listing are relatively less developed than those for initial returns. Negative abnormal returns are anomalous to an efficient market and a rational expectations approach which underlies most recent explanations of underpricing. Given the limited international evidence of longer run performance by IPOs, further analysis is warranted, especially in terms of the relationship between initial and longer run returns.

This research makes two contributions to the IPO literature. First, we resolve what we regard as a dubious explanation of Australian IPO pricing. Finn and Higham (1988) argue that underpricing of Australian IPOs reflects peculiar institutional aspects of the Australian IPO market, particularly barriers to competition among brokers and restrictions on the allocation rights of underwriters. They report large underpricing, [4] but find no evidence consistent with competitive equilibrium models such as Rock (1986). However, we argue that institutional characteristics peculiar to a given domestic environment cannot fully explain an anomaly which has proven pervasive throughout the world.

Our evidence is consistent with this view. Australian IPO underpricing for issues made between 1976 and 1989 varies in a manner consistent with the model of Rock (1986), and the extension of this by Beatty and Ritter (1986). The prevailing institutional characteristics of the Australian market during the period of our study lend weight to this view. In particular, the non-public (i.e., concealed)

[2] An informed investor is one who has perfect information about the realised value of the new issue (Rock, 1986). All other investors, and the issuer, are defined to be uninformed.

[3] See also Aggarwal and Rivoli (1990). Loughran et al. (1994) also cite examples of substantial positive post-listing returns for IPOs, although these are typically 'small sample' studies.

[4] Finn and Higham (1988) report average underpricing of 29.2% for industrial IPOs made between 1966 and 1978. However, ex post, only two of their 93 IPOs yield negative initial returns, a result inconsistent with the Rock (1986) winners' curse. This implies expectations of a significant proportion of 'overpriced' issues.

allocation procedure used for IPOs increases the possibility that favoured clients (i.e., informed investors) are able to crowd out the uninformed, thereby aggravating the winners' curse. Further, Australian 'stand-by' underwriting agreements [5] appear to increase the likelihood that uninformed investors will subscribe for overpriced issues.

Second, this paper provides additional evidence of post-listing returns for IPO firms, as well as the empirical relationship between post-listing returns and initial underpricing. Although we find that cross-sectional variation in IPO underpricing is significantly related to a proxy for fluctuations in the level of aggregate demand, competing explanations such as investor overreaction (e.g., speculative bubbles) and underpricing as a signalling mechanism, imply similar results. In order to separate these explanations, we also evaluate long-run (i.e., three-year) returns for IPOs. Our long-run evidence suggests that our sample of IPOs performs relatively poorly, with poor performance not confined to any one of the first three post-listing years. However, long-run returns are not associated with underpricing in the negative manner that the overreaction or fad explanations suggest.

The remainder of the paper proceeds as follows. In Section 2 the prevailing Australian institutional setting is reviewed, as is the role of factors specific to Australia in tests of particular models of IPO pricing. Analysis of underpricing is presented in Section 3, while evidence of longer run returns is outlined in Section 4. Conclusions and suggestions for extensions to this analysis are outlined in Section 5.

2. Background

2.1. Prior evidence

Institutional differences in IPO issuance and pricing procedures appear to play an important role in the level of initial returns, although their influence on subsequent price behaviour is less clear. Reviewing the international evidence, Loughran et al. (1994) point to two factors as potentially important determinants of IPO underpricing, namely constraints on price setting and sales procedures, and differences in the litigation environment. Australian IPOs occur in an institutional setting which has a number of noticeable differences from US and European offerings. Finn and Higham (1988) argue that, for the duration of their study, large underpricing reflects the extent to which Australian brokers have operated under restrictive trade practices. [6] Hence, they posit that brokers and (or) underwriters

[5] A stand-by arrangement means that the underwriter agrees to buy, at the issue price, any shares not taken up by investors.

[6] For the period studied by Finn and Higham (1988), as well as the period we examine, each Australian IPO required a sponsoring broker who was a member of the exchange. The sponsoring broker need not be the underwriter to the issue.

deliberately underprice issues, capturing at least part of the resulting rents. An implicit assumption is that grossly underpriced IPOs are allocated to the underwriter's favoured clients. However, Tinic (1988) argues that the US evidence does not support this view. Also, there are no explicit competitive restrictions which require US underwriters to underprice, yet underpricing is prevalent in that market. More generally, it can be asked why underwriters impose costs on issuers via underpricing rather than simply charging higher fees?

Finn and Higham's (1988) explanation for Australian IPO underpricing depends upon the continued existence of competitive restrictions which were eliminated during the latter part of the 1970s (Aitken, 1990). Thus, explanations for underpricing based on compensating brokers' clients for artificially high brokerage rates are dubious, as they require collusion between independent brokers and underwriters. Moreover, such explanations fail to offer insight into observed patterns in post-listing returns.

2.2. *Australian issuance procedures*

New shares can be issued to the public when accompanied by a prospectus registered with the relevant statutory authority. The prospectus details the number of shares to be issued and the issue price, neither of which can be changed during the course of the issue. All shares must be sold (or taken up by the underwriter) prior to trading commencing on the stock exchange. The issuer (and underwriter) is committed to a price and quantity decided on well before listing actually occurs. Red herring prospectuses are not allowed, so that formalised pre-selling of the issue cannot take place until the prospectus is registered by the statutory authorities. This cannot occur without a price having been set and stated in the prospectus.

The inability to change the issue price and (or) the quantity represents an important difference with the prevailing US environment, where subscription prices are often not determined until (non-binding) offers have been received from potential subscribers (Hanley, 1993). To the extent that this information is disclosed or is leaked, informed investors' demand is revealed, thereby lowering the expected level of underpricing. Ritter (1987) observes that US issuers face relatively low price uncertainty in setting the subscription price. The Australian method can be expected to increase heterogeneity in information availability between classes of investors. Restrictions on pre-selling should compound the importance of preferred clients for brokers and underwriters. Any 'informal' (and, strictly illegal) pre-selling of Australian IPOs would be confined to a select group, thereby reinforcing the distinction between informed and uninformed investors. Rock's (1986) model of underpricing relies on this type of heterogeneity, while the lack of widespread pre-selling rules out the explanation for underpricing offered by Benveniste and Spindt (1989), who model underpricing as a 'reward' for clients' revelation of information during the pre-selling period.

Australian prospectuses are registered with the statutory authorities for an average of seven to eight weeks prior to the commencement of trading on the Australian stock exchange. This (readily observable) time period reflects three distinct components. First, there is a period between the official registration of the prospectus and the opening of the issue to subscribers. Second, there is a period between the opening of the issue and closing, at which full (or the minimum stipulated in the prospectus) subscription is reached. [7] Finally, there is some delay between the issue closing and the commencement of exchange trading, during which the allocation of shares occurs. Given that the first and third components are largely administrative and standardised, we expect that variations in the total time which elapses between prospectus registration and the commencement of exchange trading will primarily reflect the time it takes for the issue to sell. This period proxies for fluctuations in the level of demand, principally among 'informed' investors. This view is reinforced by the allocation process used for Australian IPOs, which can conceal biases in the rationing of underpriced issues. Hence, it is likely that issues experiencing long delays have had difficulty attracting interest from 'informed' investors, reflecting the winners' curse faced by the uninformed. [8]

The form of underwriting agreement used for Australian IPOs also contributes to an expectation that IPO underpricing and the winners' curse are related. Ritter (1987) argues that relatively risky IPOs use best efforts underwriting to reduce expected underpricing through a reduction in the winners' curse faced by uninformed subscribers. Provided full subscription requires more funds than are available from uninformed investors alone, then best efforts underwriting effectively pre-commits the issuer to withdraw the offer if total demand is insufficient to meet a minimum issue condition. As Australian underwriting involves a stand-by arrangement, unlike the diversity of underwriting arrangements evidenced for US IPOs (Booth and Smith, 1986), this increases the probability that uninformed investors face a winners' curse.

The role of escrow requirements (i.e., restrictions on insider selling) for Australian IPOs enhances the possible explanatory power of signalling models which rely on the level of insiders' retained ownership (Leland and Pyle, 1977). While voluntary restrictions may add to the mandatory requirements, Australian listing regulations typically require a minimum holding period for the vendor of 12 months. Such restrictions add weight to the 'commitment' implied by retained ownership, thereby negating at least some of the criticism offered by Gale and Stiglitz (1989). They argue that insider ownership might not represent a continuing

[7] In extreme cases, this would be the date at which the underwriter takes up unsold shares.

[8] Allen (1987) describes initial public offerings in Australia as a 'game for the privileged,' noting that 'most of the shares are seen to go to institutions or favoured clients of the underwriting stockbrokers'. To the extent that institutions and highly favoured clients are most likely to be 'informed' investors, this observation is consistent with the implications of the Rock (1986) model.

commitment because secondary sales by the vendor can occur. Thus, retained ownership cannot reliably discriminate high and low quality firms at the time of the IPO.

However, while the prevailing institutional constraints lead us to anticipate some support for a winners' curse explanation of IPO underpricing (and extensions thereof), such constraints have no obvious implication for longer run returns. Models of IPO pricing based on rational expectations do not typically predict systematic post-listing underperformance of the type documented for US IPOs by Ritter (1991). [9] Moreover, some models predict stronger after-market performance for underpriced issues, on the basis that underpricing is a credible signalling mechanism. [10] In the following sections, we examine both initial and post-listing returns for Australian IPOs.

3. Data and results: Underpricing

3.1. Data sources

In order to identify Australian industrial IPOs, Australian Stock Exchange Limited (ASX) annual reports were inspected from January 1976 to December 1989 inclusive. These reports contain a summary of all deletions and additions to the official list. [11] New listings, which are a result of capital reconstructions and/or private, rather than public, equity placements, were excluded. A total of 266 industrial IPOs was identified.

Daily and monthly share prices were obtained from ASX computer records. Many new listings did not experience their initial day of trading on the Sydney Stock Exchange, which Finn and Higham (1988) used to calculate initial returns. Consequently, Finn and Higham's estimation may include a period of seasoning for such issues. Our procedure searches across trading data from all member exchanges to ensure that initial returns are based on the first day closing price. [12] Subsequent daily and monthly price data are adjusted for capitalisation changes and dividends in the usual manner.

Table 1 summarises many characteristics of Australian IPOs. The amount of funds to be raised and firm size (i.e., total assets) subsequent to the capital raising are both expressed in Australian dollars. These amounts are typically smaller than

[9] Exceptions to this include the 'cascade' model of Welch (1992), as well as the 'positive feedback' model of Rajan and Servaes (1993).

[10] Examples include Allen and Faulhaber (1989), Grinblatt and Hwang (1989) and Welch (1989).

[11] There is no over-the-counter (OTC) market in Australia (Finn and Higham, 1988). However, since the introduction of NASDAQ in 1971, United States IPOs are effectively listed on a form of exchange (Sanger and McConnell, 1986).

[12] The ASX comprises the Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart exchanges.

Table 1
Statistics for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989

Panel A: Descriptive statistics

Variable [a]	Mean	Standard deviation	Maximum	75th percentile	Median	25th percentile	Minimum
Issue size	9.050	13.244	87.000	9.975	5.000	2.400	0.214
Total assets	40.441	193.450	3055.900	26.279	12.637	7.089	0.875
Operating history	4.49	3.91	10	10	5	0	0
Time to listing	52.81	25.52	191	62	47	37	17
Standard deviation	15.11	11.40	138.55	18.26	12.65	8.82	1.61
Growth options	0.728	0.304	1	1	0.842	0.519	0
Retained ownership	54.6	22.3	93.5	70.0	58.5	45.5	0

Panel B: Distributional statistics for unadjusted and market index adjusted measures of underpricing.

Statistic	Unadjusted underpricing [b] (percent)	Market index adjusted underpricing [c] (percent)
Mean	16.41	11.86
Standard deviation	33.93	34.45
Maximum	240.00	243.81
75th percentile	20.00	17.48
Median	10.00	5.42
25th percentile	0.00	−5.92
Minimum	−50.00	−49.37
t-statistic [d]	7.89 ***	5.61 ***

[a] Issue size = equity issue size ($ millions). Total assets = total assets after initial equity issue ($ millions). Operating history = length of prior operating history (years). Time to listing = time between prospectus registration and exchange listing (days). Standard deviation = standard deviation of monthly returns for the twelve months post listing (percent). Growth options = proportion of the subscription price per share represented by growth options. Retained ownership = proportion of the equity retained by previous owners (percent).

[b] Calculated as closing sale price on first day of listing divided by subscription price per share, minus unity.

[c] Calculated as per the unadjusted underpricing in [b] *less* the market index value on the listing date divided by the market index on the prospectus registration date minus unity.

[d] *T*-statistic that the mean return equals zero.

*** Significant at $\alpha = 0.01$.

for comparable US studies. Our proxy for fluctuations in the relative level of informed demand, namely the number of days between prospectus registration and exchange listing, which on average is 53 days, is also summarised in Table 1. Unlike Koh and Walter (1989) and Keloharju (1993), it is not possible to directly test Rock's (1986) model by observing the nature and extent of issue rationing on the offer date. However, as explained in Section 2, those issues which close (and therefore list) most rapidly are expected to have the highest level of informed demand. We expect these issues to display relatively larger underpricing. While Finn and Higham (1988) find no statistically significant relationship between a similar proxy and Australian IPO underpricing, this is hardly surprising given that the distribution of initial returns in the period they study is, ex post, inconsistent with a winners' curse.

Issue size and firm size have frequently been used to proxy investors' ex ante uncertainty (Beatty and Ritter, 1986), and other potential proxies include the length of operating history prior to going public and the post-listing standard deviation of the first 12 monthly share returns. [13] These variables are summarised in Table 1, along with our proxy for the extent to which the subscription price represents the purchase of growth options (as distinct from unencumbered assets-in-place). This may represent a more direct measure of potential uncertainty (and therefore, information asymmetry) than the measures used by Beatty and Ritter (1986). [14]

3.2. Evidence of underpricing

Underpricing is reported in Table 1. Raw returns are calculated as

$$R_i = (P_i - S_i)/S_i \tag{1}$$

so that R_i is the return of firm i's share, calculated as the difference between the last sale price on the day of initial listing (P_i) and the subscription price (S_i), divided by the subscription price. Average raw underpricing is 16.4%, lower than the 29.2% reported by Finn and Higham (1988). Unlike Finn and Higham, we observe a relatively large number of overpriced issues, such that the distribution is quite highly skewed. This is consistent with the existence of a winners' curse in the IPO market, although a benchmark of zero may not be an appropriate comparison, overstating the 'abnormal' returns to IPO subscribers. Hence, we also

[13] We also estimated the standard deviation of returns for the first 15 days of trading, although thin trading makes this measure less reliable. There is no significant difference in the results using this measure to those subsequently reported.

[14] This figure is calculated as (subscription price per share − net tangible assets per share)/(subscription price per share) where cash is excluded from tangible assets to reflect uncertainty about the 'value' of its application.

report market adjusted returns (R'_i), an approach analogous to the zero-one version of the familiar market model, so that

$$R'_i = R_i - R_m. \tag{2}$$

The market adjustment (R_m) noticeably lowers estimated underpricing. [15] After the market adjustment, around one third of all IPOs are overpriced (i.e., yield a negative market adjusted return). This result reinforces the highly skewed nature of IPO returns. [16]

3.3. Cross-sectional variation in underpricing

Five variables were described in Table 1 which may act as potential proxies for ex ante uncertainty about market value, namely issue size, firm size (total assets), post-listing price variation, length of prior operating history and the proportion of subscription price representing growth options. From Rock (1986) and Beatty and Ritter (1986), we expect a positive relationship between ex ante uncertainty and underpricing. As discussed in Section 2, the elapsed time between prospectus registration and eventual listing may capture the extent to which uninformed investors face a winners' curse, via the presence or absence of informed investor demand. We expect a negative relationship between underpricing and the listing delay.

We also consider the influence of retained ownership on the level of underpricing. Institutional considerations discussed in Section 2.2 (e.g., escrow requirements of 12 months or more) support a signalling role. However, the direction of any observed relationship with underpricing is argued to depend on the level of uncertainty about future cash flows (Grinblatt and Hwang, 1989), making cross-sectional analysis relatively difficult.

Univariate regressions (not reported) were initially performed with market adjusted underpricing as the dependent variable, and a statistically significant relationship was observed with our proxy for fluctuations in informed demand, in a manner consistent with Rock's (1986) prediction. [17] This result is in marked

[15] The All Ordinaries Accumulation Index was used to measure R_m for issues after 1 January, 1980 (the inception of the index). Prior to that, the Statex Actuaries Accumulation Index was used. Of course, to the extent that the systematic risk of the security exceeds one, the zero–one version of the market model will overstate the extent of 'abnormal' returns, if R_m is positive.

[16] We also find that underpricing is not temporally stable. While underpricing is evident throughout the period, our results (available on request) suggest that evidence of underpricing may lead the decision to go public for many issues. A period of high underpricing (e.g., most of 1986) is followed by a rise in IPO frequency during 1987. This relationship, although only tentative, is consistent with evidence summarised by Ibbotson et al. (1988), who suggest that 'hot issue markets' are not marked by high IPO volume, but rather that such increases in volume follow shortly thereafter.

[17] Similar, although typically slightly weaker, results are obtained using raw (i.e., unadjusted) underpricing. All results are available from the authors on request.

contrast to Finn and Higham (1988), further supporting the view that institutional characteristics offset the winners' curse in the period they studied. Some influence on underpricing is also found for issue size and post-listing price variation, as well as the level of retained ownership. These are all possible proxies for ex ante uncertainty. However, as with other studies using 'risk' proxies which are observable ex ante, the explanatory power of the issue size and post-listing price variation variables is relatively low compared with the informed demand proxy (which is only observable ex post). Moreover, the positive relationship between retained ownership and underpricing is inconsistent with univariate signalling models.

We expect *both* the level of ex ante uncertainty and the degree of informed demand to affect the level of underpricing. To investigate the combined effect, we employ multivariate regression, where the dependent variable is the market adjusted return to IPO subscribers. A potential problem with this approach is the existence of significant heteroscedasticity in the error term. [18] Accordingly, we use ordinary least squares (OLS) regression with a heteroscedasticity consistent covariance matrix (White, 1980). Multivariate results are reported in Table 2, along with the expected sign of each coefficient and the *t*-statistic resulting from the procedure described by White (1980). These results support the role of Rock's (1986) winners' curse model of underpricing, both directly (demand) and indi-

[18] Johnstone (1984) discusses the impact of heteroscedasticity in detail. Analysis of the residuals from the unreported univariate regressions show significant heteroscedasticity for all explanatory variables except for our proxy for the level of informed demand (i.e., time to listing).

Notes to Table 2:

[a] Calculated as closing sale price on first day of listing divided by subscription price per share, minus unity, *less* the value of the market index on the listing date divided by the market index on the prospectus registration date, minus unity.

[b]

	Expected Sign
Issue size = natural logarithm of equity issue size ($ millions)	(−)
Total assets = natural logarithm of total assets after initial equity issue ($ millions)	(−)
Operating history = length of prior operating history (years)	(−)
Time to listing = time between prospectus registration and exchange listing (days)	(−)
Standard deviation = standard deviation of monthly returns for the twelve months post listing (percent)	(+)
Growth options = proportion of the subscription price per share represented by growth options	(+)
Retained ownership = proportion of the equity retained by previous owners (percent)	(+)

*** Significant at $\alpha = 0.01$.

** Significant at $\alpha = 0.05$.

* Significant at $\alpha = 0.10$.

Table 2
Multivariate regression analysis of cross-sectional variation in market index adjusted measures of underpricing [a] for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989 for various combinations of explanatory variables, with related *t*-statistics in parentheses.

Regression estimates	Model number					
	1	2	3	4	5	6
Intercept	0.2660	0.2333	0.2326	0.1405	0.1772	0.1502
	(0.746)	(0.804)	(0.826)	(1.665) * *	(2.322) * *	(2.108) * *
Slope coefficients on: [b]						
Issue size	−0.0118	−0.0055	−0.0056			
	(−0.360)	(−0.362)	(−0.363)			
Total assets	0.0065					
	(0.199)					
Operating history	−0.0132	−0.0131	−0.0131	−0.0131	−0.0144	
	(−2.305) * *	(−2.286) * *	(−2.312) * *	(−2.309) * *	(−2.544) * * *	
Time to listing	−0.0035	−0.0035	−0.0035	−0.0035	−0.0035	−0.0034
	(−3.559) * * *	(−3.563) * * *	(−3.594) * * *	(−3.591) * * *	(−3.664) * * *	(−3.705) * * *
Standard deviation	0.0017	0.0016	0.0016	0.0016		
	(1.125)	(1.120)	(1.107)	(1.091)		
Growth options	0.0032	−0.0010				
	(0.042)	(−0.015)				
Retained ownership	0.0034	0.0035	0.0035	0.0036	0.0036	0.0027
	(3.083) * * *	(2.998) * * *	(3.058) * * *	(3.350) * * *	(3.304) * * *	(2.881) * * *
Adjusted R^2	0.1224	0.1257	0.1290	0.1321	0.1327	0.1128
F-statistic	6.279 * * *	7.349 * * *	8.853 * * *	11.084 * * *	14.518 * * *	17.840 * * *

rectly (ex ante uncertainty). Hence, it appears that peculiar institutional characteristics prevailing in the period studied by Finn and Higham (1988) can overwhelm the winners' curse. [19] This reinforces the need to pay close attention to institutional detail in testing equilibrium models of underpricing.

However, as noted previously, evidence of increased demand being positively associated with underpricing is also consistent with explanations based on 'speculative bubbles' and (or) systematic overvaluation. Of course, such arguments cannot explain why other ex ante uncertainty proxies are also significant explanators of underpricing. [20] To consider the merit of these alternative explanations for IPO underpricing, evidence of longer run returns is required.

4. Long-run returns

4.1. Method

In order to gain further understanding of IPO underpricing, we analyse share returns in the three years subsequent to listing. 'Fad' or 'speculative bubble' explanations of initial underpricing suggest a link between initial returns and post-listing performance, as do those explanations in which underpricing is modelled as a signal of future performance. However, the direction of the relationship between initial and subsequent performance differs between these two approaches, so that analysis of 'long-run' returns represents an important input into a thorough analysis of underpricing. Moreover, while IPO underpricing is widely documented, there is relatively little evidence of long-run performance.

Ritter (1991) documents substantial under-performance of US IPOs occurring between 1975 and 1984 relative to a matched control group. Several potential explanations for this result are presented, including risk mis-measurement, bad luck, and fads or overvaluation. Ritter notes that subsequent under-performance is concentrated among relatively young, 'blue-sky' firms which went public during years of relatively high IPO activity. However, it is difficult to test this argument because there is a limited number of observable 'market conditions'. Thus, additional longer run evidence (i.e., different countries and time periods) is warranted.

For all 266 IPOs described in Table 1, long-run returns are estimated for the three years following listing. Our method differs from Ritter, in that we rely on

[19] We conducted additional tests to determine if our results were sensitive to clustering of IPOs in 1986 or the effects of the 1987 stockmarket crash. They were not.

[20] A possible exception is Miller (1977), who argues that the divergence between optimistic and pessimistic investors (and hence, the level of underpricing) will be greater for relatively risky (i.e., uncertain value) new issues. However, this argument also extends to post-listing price behaviour, predicting subsequent reversals in value, with 'over-valued' (i.e., underpriced) issues most adversely affected.

market adjusted, rather than control-firm-adjusted returns. In addition, the use of 'independent' monthly rebalancing, whereby equal weights determined monthly imply an increasing investment in poorly performing firms, is avoided. This technique may bias downwards the long-run returns reported by Ritter. [21] Monthly returns are calculated as the raw return minus the monthly return for the All Industrials Accumulation Index. [22] The month zero return is for the first month following listing, excluding initial underpricing. Many IPOs delist before three years. These were investigated to determine whether the last trade price was indicative of the cash return available to stockholders. [23] In such cases, investment of the final proceeds in the market index was assumed for subsequent periods. Where delisting reflected bankruptcy or other forms of financial distress, full loss of the investment was recorded.

Our method is described as follows. Initially market adjusted returns are calculated for each security i and period t as

$$R_{i,t} = \frac{P_{i,t} + d_{i,t}}{P_{i,t-1}} - \frac{I_t}{I_{t-1}} \tag{3}$$

where

$P_{i,t}$ = the price of security i in period t,

$d_{i,t}$ = the value of any dividend or capitalisation change for security i in period t, and

I_t = the market index value in period t.

These returns are averaged to form portfolio returns for a given month,

$$AR_t = \sum_{i=1}^{n} \frac{R_{i,t} * x_i * P_{i,t-1}}{\sum_{i=1}^{n} x_i * P_{i,t-1}} \tag{4}$$

where

$x_i = 1/S_i$ or $Z_i/100$, depending on the weighting scheme used,

where

S_i = the subscription price per share, and

Z_i = the total number of shares on issue.

Portfolio returns for the three-year period are then formed as

$$CAR_t = \prod_{t=1}^{36}(1 + AR_t) - 1 \tag{5}$$

[21] Further, the rebalancing assumptions inherent in Ritter's approach do not produce a feasible investment strategy because the cross-sectional averages combine returns for firms drawn from different calendar time intervals.

[22] This index is an accumulation index for all industrial listings (i.e., it includes dividends). No extractive industry firms are included in this index, consistent with the exclusion of such firms from our investigation.

[23] For example, if delisting occurred due to takeover, investors were assumed to have received the offer price.

Hence, our long-run measures are based on a buy and hold strategy which is initiated at the last sale on the first day of listing. Two weighting schemes are employed. The first assumes an equal investment in each IPO (and the market index). The second assumes an acquisition of one percent of the new issue, and investment of the same dollar amount in the market index. Poorly (above average) performing firms become less (more) important because their value-weights to the portfolio of IPOs are reduced (increased).

4.2. *Long-run evidence*

Table 3 reports monthly average and cumulative average returns, commencing from the first day of listing. The equally weighted CAR at month 36 is −51.259 percent; thus an equal investment in each of these IPOs would have resulted in a loss of approximately half of the value of the initial portfolio within a three-year period. Twenty-three of the monthly average returns are significantly negative, while only one is significantly positive. (Thirty-two average residuals are negative, while only four are positive.) These results suggest the same general findings as in Ritter (1991), namely that this sample of IPOs, on average, performs quite poorly over the longer run. [24] Because data are not available to estimate systematic risk, it is possible that our results are due to an inappropriate assumption that the beta coefficient for all IPOs is both stable over the three-year period and equal to unity. However, a closer analysis suggests that this is extremely unlikely. Specifically, only 42 of the IPOs were followed by a period where the market return was negative. The average market return for these was −11.90 percent. However, 224 IPOs were followed by positive market returns in the post-listing period, and these averaged 70.11 percent. Only if the systematic risk of the 42 IPOs was 31 times as great as that of the 224, would the effect of negative market returns in the seasoning period offset the effect of the positive market return. An error in estimation of beta of this magnitude is extremely unlikely. We conclude that this sample of IPOs has anomalously poor post-listing returns.

Further, the performance of these Australian IPOs is considerably worse than that in Ritter's study. [25] As evidence on this, note that the sample size in Table 3

[24] We replicated the weighting scheme employed by Ritter (1991, p. 10) and found a three year cumulative abnormal return of −83.17 percent.

[25] We calculated 'wealth relatives', which Ritter (1991) defines as the ratio of one plus the mean IPO holding period return divided by one plus the mean matching firm (in our case the market index) return. Our three-year wealth relative is 0.535, which reinforces the poor long-run performance of the Australian IPOs we study. Ritter (1991) reports a three-year matched firm wealth relative of 0.831, while Loughran and Ritter (1993) report 0.830 for their sample. Keloharju (1993) reports a three-year market index matched wealth relative of 0.789. While the US firms studied by Ritter (1991) and Loughran and Ritter (1993), and the Finnish firms studied by Keloharju (1993) all perform poorly relative to their respective matches, their long-run performance is not as poor as that of our sample of Australian IPOs.

Table 3
Post-listing long-run average and cumulative average return behaviour for 36 months (where month one represents the market index adjusted return [a] from the last sale price on the day of listing to the end of that calendar month) subsequent to listing for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989, calculated on the basis of a buy-and-hold strategy initiated using an equal dollar investment in each issue purchased at the offer price for the issue.

Month	Number of firms	Average return (percent)	*T*-statistic on the average return [b]	Cumulative average return (percent)
1	266	−1.129	−1.135	−1.129
2	266	−2.925	−3.104 ***	−4.021
3	266	−1.457	−1.683 **	−5.420
4	266	−2.609	−2.891 ***	−7.887
5	266	2.085	0.898	−5.967
6	266	3.559	1.359 *	−2.621
7	266	−1.135	−1.227	−3.725
8	266	−1.743	−2.027 ***	−5.404
9	266	−4.113	−3.995 ***	−9.294
10	266	−0.679	−0.620	−9.910
11	265	−3.489	−3.512 ***	−13.054
12	263	−0.515	−0.572	−13.502
13	260	−3.434	−3.343 ***	−16.472
14	260	−3.335	−3.751 ***	−19.258
15	259	−0.245	−0.207	−19.456
16	258	−3.025	−3.183 ***	−21.892
17	251	0.164	0.138	−21.763
18	250	2.346	2.232 **	−19.928
19	250	−3.578	−3.437 ***	−22.793
20	248	−2.940	−3.033 ***	−25.063
21	247	−1.617	−1.757 **	−26.275
22	245	−1.818	−1.688 **	−27.615
23	244	−3.368	−3.368 ***	−30.053
24	240	−1.396	−1.317 *	−31.029
25	237	−5.204	−5.486 ***	−34.619
26	233	−2.260	−2.563 ***	−36.096
27	230	−2.564	−2.797 ***	−37.735
28	227	−4.108	−4.212 ***	−40.293
29	224	−3.863	−4.127 ***	−42.599
30	220	−0.733	−0.775	−43.020
31	218	−4.922	−4.702 ***	−45.824
32	217	−2.586	−2.805 ***	−47.225
33	213	−0.439	−0.422	−47.457
34	199	−2.053	−1.717 **	−48.536
35	185	−1.540	−1.306 *	−49.329
36	169	−3.809	−4.164 ***	−51.259

reduces from 266 to 169 in the three-year period; 52 firms have less than 36 months of available prices, while 45 firms are removed due to:

- a successful takeover 13 firms,
- liquidation with no cash return to shareholders 19 firms,
- failure to pay listing fees 12 firms,
- transfer to the mining lists 1 firm.

Taken together, 31 of the 266 IPOs were liquidated or were delisted following a failure to pay listing fees, within three years of listing, resulting in shareholders losing their complete investment. [26] The probability of removal for these reasons, conditional on being in our set of IPOs, is 3.88 percent per annum. When the same probability is estimated for the population of listed industrial companies during the ten-year period from 1 July 1982 to 30 June 1991, the estimate is 2.24 percent, though if the abnormal year to 30 June 1991 is excluded (where the failure rate was 10.95 percent), the failure rate is estimated as 1.31 percent. [27] Our sample of IPOs fail at a rate two to three times higher than the industrial population, reinforcing our interpretation that their long-run performance is abnormally poor.

Our conclusions are generally robust to the method of weighting, as well as the use of other than market adjusted returns. Fig. 1 provides a summary of four measures of long-run returns and two market index measures. Irrespective of the method of weighting, the post-listing performance of the IPOs is negative, in contrast to the positive returns for the market index. Plots of performance on a year-by-year basis, and a plot excluding IPOs which span the 1987 sharemarket fall, show that poor performance is present in each of these subsets.

Table 4 reports distributional information for one-, two- and three-year post-listing returns, commencing from the first day of listing. In each set of results

[26] In addition, a further eleven IPOs failed (again with shareholders losing their complete investment) during the period from three to five years of seasoning. The raw return for these at month 36 averaged −68.9 percent. Only one of these eleven had a positive raw return at month 36, while six had raw returns lower than −90.0 percent. Clearly, the market had judged the prospects of these eleven firms to be very poor by month 36 of seasoning.

[27] Da Silva Rosa (1994) analyses the reasons for delisting of industrial and mining companies between 1920 and 1989. During this 70 year period 771 firms were delisted for reasons which imply the company had failed. Given the average number of listed firms in this period is 930, the probability of failure is 1.18 percent per year. The failure rate among mining companies is somewhat higher than for industrials, and accordingly an industrial failure rate of around one percent per annum prevailed over this longer estimation interval.

Notes to Table 3:

[a] Calculated as closing sale price on the last day of the month divided by the closing price on the last trading day of the previous month (or the first day of listing in the case of the first month), minus unity, *less* the percentage change in the market index over the corresponding period.

[b] *T*-statistic that the average return equals zero.

*** Significant at $\alpha = 0.01$

** Significant at $\alpha = 0.05$

* Significant at $\alpha = 0.10$

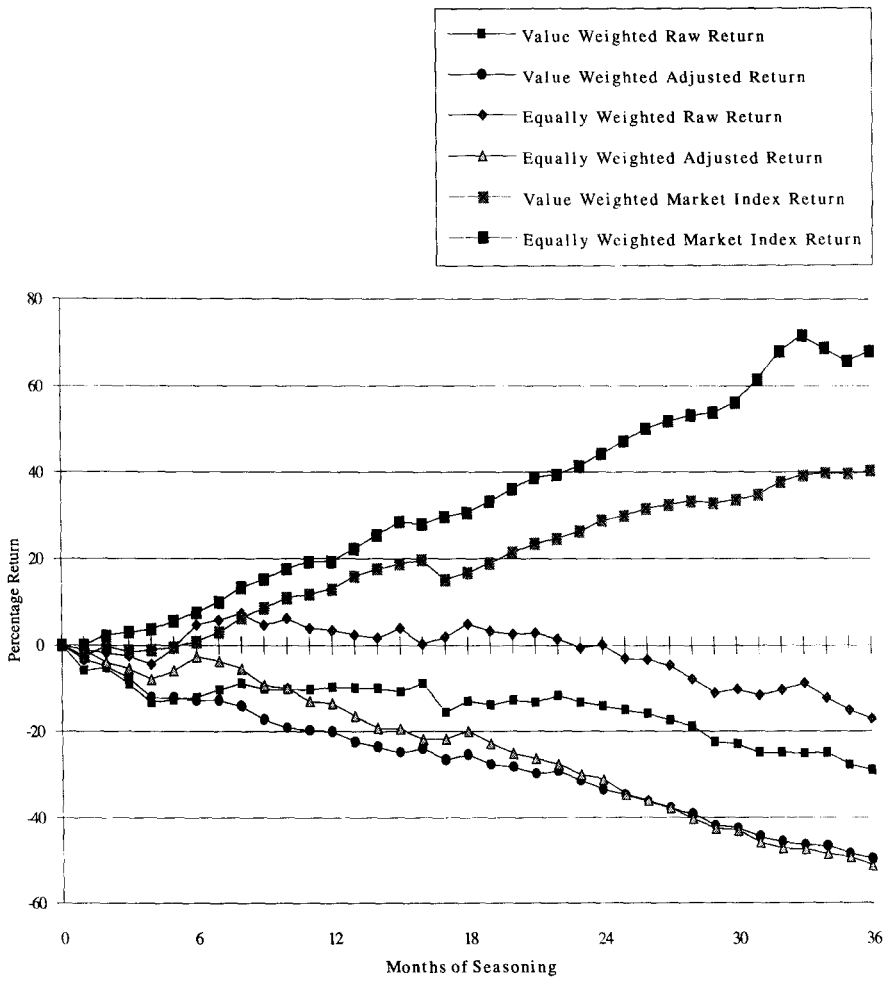

Fig. 1. Alternative definitions of market index returns and post-listing performance for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989.

(which are not, of course, independent) more than 75 percent of the sample has negative market adjusted returns. The medians for the one, two and three years of post-listing returns are −30.6 percent, −51.0 percent and −63.8 percent respectively. It is again apparent that the poor performance is not confined to the first post-listing year. It continues throughout the three-year period.

Additional analysis was conducted as follows, though the detailed results are not reported. Cross-sectional variations in post-listing returns, initially using the same explanatory variables as reported in Table 2, were examined using univariate

Table 4
Distributional statistics for long-run average market index adjusted returns [a] subsequent to listing for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989, calculated on the basis of a buy-and-hold strategy initiated using an equal dollar investment in each issue purchased at the offer price for the issue, for a holding period of one, two and three years.

Statistic	One-year average returns (percent)	Two-year average returns (percent)	Three-year average returns (percent)
Minimum	−100.000	−100.000	−100.000
25th percentile	−53.600	−74.434	−87.949
Median	−30.597	−51.021	−63.755
75th percentile	−4.220	−21.812	−33.820
Maximum	1035.539	816.682	256.437
Mean	−18.768	−35.602	−51.581

[a] Calculated as closing sale price on the last day of the 12th, 24th and 36th month (adjusted for changes in the basis of capitalisation) divided by the closing price on the first day of listing, minus unity, *less* the percentage change in the market index over the corresponding period.

regressions. [28] First, these show that one-year post-listing returns are weakly associated with issue size and our proxy for the (initial) level of informed demand. Smaller issues have relatively superior post-listing performance, while issues which fill and list relatively quickly outperform those that take a longer time to fill. Assuming this is an appropriate proxy for fluctuations in informed demand, the latter result suggests that informed investors are able to distinguish underpriced issues relative to their 'true value'. However, for two- and three-year post-listing returns, the proxies for informed demand and issue size do not have significant explanatory power.

Second, and somewhat surprisingly, initial levels of retained ownership have a statistically significant negative relationship with two- and three-year post-listing returns, and the strength of this relationship appears to increase with the passage of time. This result contradicts the signalling role for retained ownership suggested by Leland and Pyle (1977). Gale and Stiglitz (1989) point to the possible reduction in initial levels of retained ownership via subsequent equity offerings, and these may be viewed (relatively) adversely, thereby negating any positive relationship between retained ownership and subsequent returns.

Additional univariate analysis (again unreported) shows that initial returns are positively associated with one-year post-listing returns, though the significance of this disappears as the post-listing period is extended from one to two or three years. In contrast, Ritter (1991) finds a weak negative relationship between initial and subsequent returns, although he only reports results for a three-year holding

[28] Results discussed are for regressions using market index-adjusted returns. Qualitatively similar results occur when raw returns are substituted.

period. Although Ritter's result may be viewed as weakly supportive of 'overvaluation' (or 'fad') explanations for IPO underpricing, an alternative explanation suggested by Rajan and Servaes (1993) is that the relationship between initial and subsequent returns may not be linear. [29] This possibility is incorporated into the multivariate regressions, the results of which are reported in Table 5.

Table 5 reports evidence of an increasingly negative association between levels of initial retained ownership and post-listing returns, in contradiction to the prediction of Leland and Pyle (1977). Table 5 results show our proxy for fluctuations in the level of informed demand is insignificant once underpricing and underpricing squared are included as explanatory variables. Issue size continues to have a weak negative association with one-year returns, but no statistically significant association with longer post-listing periods.

Most importantly, we find evidence of a curvilinear association between initial and subsequent one- and two-year returns (i.e., a hump-shaped relationship), although this is not the case when three-year returns are used. One- (two-) year returns are increasing with the level of underpricing up to a maximum initial return of 94% (89%). These turning points are well beyond the mean and median levels of market-adjusted underpricing reported in Table 1, and only 8 IPOs have initial returns greater than these amounts. Hence, for the vast majority of our IPOs, there is a positive (but decreasing) relationship between initial and subsequent returns. One caveat, however, is that the truncated nature of IPO returns (i.e., minimum 100%, maximum unbounded) may misrepresent the 'true' shape of any curvilinear relationship. With only 8 IPOs underpriced by more than the estimated turning points, these results should be viewed with some caution. [30] Another caveat worthy of note is that the explanatory power of the regressions in Table 5 are low. While some statistical significance is encountered, the economic significance of these results is problematic.

To the extent that our IPOs are clustered temporally, one possible interpretation of the results is that the weakening of the curvilinear relationship as the post-listing period is extended reflects the switch from bull to bear market conditions between one to two years after many of these IPOs occurred. If initial returns are also attributable to market-wide rather than firm-specific factors, our long-run analysis may be viewed as partially supportive of 'feedback' models of the type

[29] Rajan and Servaes (1993) model the effect of market conditions on IPO pricing and subsequent returns and suggest that IPO issuers must consider price insensitive demand (i.e., investor 'sentiment' at the time of the issue) as well as 'feedback risk' (i.e., trend chasing). They argue that issues which are most overpriced and underpriced will perform relatively poorly in the long run.

[30] Another reason for caution is the relatively low R-squares for our regression, though the one- and two-year F-statistics are significant. We did not expect that these models would have high explanatory power (and economic significance) because this implies that long-run sharemarket performance could be predicted at the IPO date.

Table 5
Multivariate regression analysis of cross-sectional variation in long-run market index adjusted returns [a] subsequent to listing for 266 Australian industrial initial public offers of ordinary equity made between January 1976 and December 1989, calculated on the basis of an equal dollar investment in each issue purchased at the offer price for the issue, for a holding period of one, two and three years for various explanatory variables, with related *t*-statistics in parentheses

Regression estimates	Dependent variable		
	One-year average returns	Two-year average returns	Three-year average returns
Intercept	1.7203	1.2215	0.0660
	(1.145)	(0.892)	(0.102)
Slope coefficients on: [b]			
Issue size	−0.0985	−0.0796	−0.0307
	(−1.338) *	(−1.154)	(−0.861)
Time to listing	−0.0016	−0.0004	0.0009
	(−0.782)	(−0.191)	(0.648)
Retained ownership	−0.0065	−0.0067	−0.0032
	(−1.221)	(−1.435) *	(−1.590) *
Underpricing	0.8708	0.6951	0.2697
	(2.245) * *	(2.096) * *	(1.531) *
Underpricing squared	−0.4635	−0.3884	−0.1203
	(−2.493) * * *	(−2.329) * * *	(−0.863)
Adjusted R^2	0.0552	0.0270	0.0038
F-statistic	4.095 * * *	2.470 * *	1.202

[a] Calculated as closing sale price on the last day of the 12th, 24th and 36th month (adjusted for changes in the basis of capitalisation) divided by the closing price on the first day of listing, minus unity, *less* the percentage change in the market index over the corresponding period.
[b] Issue size = natural logarithm of equity issue size ($ millions). Time to listing = time between prospectus registration and exchange listing (days). Retained ownership = proportion of the equity retained by previous owners (percent). Underpricing = market index adjusted underpricing (percent). Underpricing squared = underpricing * underpricing (percent squared).
* * * Significant at $\alpha = 0.01$.
* * Significant at $\alpha = 0.05$.
* Significant at $\alpha = 0.10$.

offered by Rajan and Servaes (1993), or possibly the cascade model of Welch (1992). However, until studies of this type can include several IPO 'clusters' (i.e., at least 20–30 years of data) we regard such conclusions as tentative at best.

5. Summary

Our research makes two contributions to the existing IPO literature. First, we resolve a dubious argument in the previous Australian IPO literature. Finn and Higham (1988) argue that underpricing of Australian IPOs reflects peculiar institutional aspects of the Australian IPO market. However, institutional charac-

teristics peculiar to a given domestic environment cannot fully explain an anomaly which has proven pervasive throughout the world. Evidence consistent with this view is provided. Australian IPO underpricing for issues made between 1976 and 1989 varies in a manner consistent with the model of Rock (1986), and the extension by Beatty and Ritter (1986).

Second, the paper provides evidence of the long-run returns for Australian IPO firms, as well as the relationship between post-listing returns and initial underpricing. Our long-run evidence shows that IPOs performs poorly in the ensuing three years, with poor performance not confined to any one of the first three post-listing years. Long-run returns are not associated with underpricing in the manner that overreaction or fad explanations suggest.

We find evidence of a curvilinear relationship between underpricing and subsequent one- and two-year returns. Although recent evidence from subsequent equity offerings casts doubt on the role of IPO underpricing as a potential signalling mechanism (Jegadeesh et al., 1993), our results are at least weakly supportive of such a role, as most of the IPOs were found to have initial underpricing which is positively related to subsequent long-run returns. However, our results could also be consistent the feedback model of Rajan and Servaes (1993). Given the difficulty of testing these explanations without considerable temporal variation in market conditions, we view these tests as tentative. Moreover, the poor long-run performance of these Australian IPOs is anomalous to market efficiency, which suggests a need for further analytical and empirical research.

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References

Aggarwal, Reena and Pietra Rivoli, 1990, Fads in the initial public offering market?, Financial Management 19, 45–57.

Aitken, Michael J., 1990, The Australian securities industry under negotiated brokerage commissions: Evidence of the effects of change on the structure of the industry, Journal of Business Finance and Accounting 17, 213–245.

Allen, Franklin and Gerald R. Faulhaber, 1989, Signaling by underpricing in the IPO market, Journal of Financial Economics 23, 303–323.

Allen, Richard, 1987, Sharemarket: Floats, the game for the privileged, Business Review Weekly 9, 124–129.

Beatty, Randolph R. and Jay R. Ritter, 1986, Investment banking, reputation, and the underpricing of initial public offerings, Journal of Financial Economics 15, 213–232.

Benveniste, Lawrence M. and Paul A. Spindt, 1989, How investment bankers determine the offer price and allocation of new issues, Journal of Financial Economics 24, 343–361.

Booth, James R. and Richard L. Smith, 1986, Capital raising, underwriting and the certification hypothesis, Journal of Financial Economics 15, 261–281.

Da Silva Rosa, Raymond, 1994, Measuring long-run sharemarket performance: The impact of survivorship bias, returns asymmetry, and firm size, Working paper (Research Centre in Accounting and Finance, University of Western Australia, Nedlands) Aug.

Finn, Frank J. and Ron Higham, 1988, The performance of unseasoned new equity issues-cum-stock exchange listings in Australia, Journal of Banking and Finance 12, 333–351.

Gale, Ian and Joseph E. Stiglitz, 1989, The information content of initial public offerings, Journal of Finance 44, 469–477.

Grinblatt, Mark and Chuan Y. Hwang, 1989, Signalling and the pricing of new issues, Journal of Finance 44, 393–420.

Hanley, Kathleen W., 1993, The underpricing of initial public offerings and the partial adjustment phenomenon, Journal of Financial Economics 34, 231–250.

Ibbotson, Roger G., Jody L. Sindelar and Jay R. Ritter, 1988, Initial public offerings, Journal of Applied Corporate Finance 1, 37–45.

Jegadeesh, Narasimhan, Mark Weinstein and Ivo Welch, 1993, An empirical investigation of IPO returns and subsequent equity offerings, Journal of Financial Economics 34, 153–175.

Johnstone, John, 1984, Econometric Methods, 3rd edition, (McGraw Hill, Singapore).

Keloharju, Matti, 1993, The winner's curse, legal liability, and the long-run price performance of initial public offerings in Finland, Journal of Financial Economics 34, 251–277.

Koh, Francis and Terry Walter, 1989, A direct test of Rock's model of the pricing of unseasoned issues, Journal of Financial Economics 23, 251–272.

Leland, Hayne E. and David H. Pyle, 1977, Information asymmetries, financial structure, and financial intermediaries, Journal of Finance 32, 317–387.

Levis, Mario, 1993, The long-run performance of initial public offerings: The UK experience 1980–1988, Financial Management 22, 28–41.

Loughran, Tim and Jay R. Ritter, 1993, The timing and subsequent performance of IPOs: Implications for the cost of equity capital, Working paper (University of Illinois, Urbana-Champaign, IL) April.

Loughran, Tim, Jay R. Ritter and Kristian Rydqvist, 1994, Initial public offerings: International insights, Pacific-Basin Finance Journal 2, 165–199.

Miller, Edward M., 1977, Risk, uncertainty, and divergence of opinion, Journal of Finance 32, 1151–1168.

Rajan, Raghuram and Henri Servaes, 1993, The effect of market conditions on initial public offerings, Working paper (University of Chicago, Chicago, IL).

Ritter, Jay R., 1987, The costs of going public, Journal of Financial Economics 19, 269–281.

Ritter, Jay R., 1991, The long-run performance of initial public offerings, Journal of Finance 46, 3–27.

Rock, Kevin, 1986, Why new issues are underpriced, Journal of Financial Economics 15, 187–212.

Sanger, Gary C. and John J. McConnell, 1986, Stock exchange listings, firm value, and security market efficiency: The impact of NASDAQ, Journal of Financial and Quantitative Analysis 21, 1–25.

Tinic, Seha M., 1988, Anatomy of initial public offerings of common stock, Journal of Finance 43, 789–822.

Welch, Ivo, 1989, Seasoned offerings, imitation costs, and the underpricing of initial public offerings, Journal of Finance 44, 421–449.

Welch, Ivo, 1992, Sequential sales, learning, and cascades, Journal of Finance 47, 695–732.

White, Halbert, 1980, A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity, Econometrica 48, 817–838.