Valuation of underwriting agreements for UK rights issues: evidence from the traded option market

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Abstract

In the United Kingdom, almost all equity rights issues are underwritten. Recently, some have argued that the fee charged by underwriters for this service is too high. This paper compares the fee charged by sub-underwriters with the cost of buying a similar put option in the traded option market. Although the option supplied by sub-underwriters could not in practice be purchased in the traded option market, we feel that this comparison is fairer than the simple theoretical Black and Scholes value used in other studies (eg Marsh (1994)). We find that, although the option value is higher than estimated by Marsh, it is still less than the fee charged by sub-underwriters.

1. Introduction

In the United Kingdom the vast majority of rights issues are underwritten, with a lead underwriter, supported by up to 400 sub-underwriters, committing to buy the issue if it is not fully taken up. Over the last few years there has been a vigorous debate over the fee charged by underwriters for this service. Many have argued that their fees are excessive and have pointed to their fixed nature as evidence of inefficiency. Others have argued that the fees are a fair reward for the risks borne and that the fixed fee is simply a convenience that allows underwriting to be arranged quickly. They note that, although the fee is fixed, the choice of price at which the issue is underwritten is open to negotiation and is used to adjust for differences in risk between issues.

Several studies have attempted to resolve this debate by calculating the returns to underwriting. These have used two methods. First, an *ex-ante* approach where the value of the underwriting cover is established using an option pricing model and this option price is then compared with the fee. Second, an *ex-post* approach where the actual returns on underwriting are established by comparing the *ex-post* costs (for issues where the underwriter is left holding a large proportion of the issue) with the fee received. Results from these studies indicate that underwriters consistently earn abnormal returns and that this also holds in markets other than the United Kingdom.

However, both approaches are problematic; the *ex-ante* approach assumes sub-underwriters can hedge their positions perfectly while the *ex-post* approach assumes they are risk neutral. In addition, both approaches assume sub-underwriters face negligible transaction costs and are not subject to adverse information costs. If any of these assumptions are violated then

both the *ex-ante* and *ex-post* return as calculated in these studies will appear abnormal even for fairly priced underwriting. This paper attempts to allow for these potential costs by comparing the cost to the firm of paying underwriting fees with the cost of buying put options in the traded option market. Since market-makers in the traded option market can be assumed to face costs - relating to risk (given that perfect hedges cannot practically be constructed), adverse information and transactions costs - similar to those of underwriters, their returns can be related to the fair return for underwriting. This is not to say that a firm could in practice use the traded option market as an alternative method of underwriting (currently the market is probably too thinly traded to cope with such a large trade as a rights issue) but simply that it provides a fairer measure of value than simply ignoring factors such as bid-ask spreads.

The rest of the paper is organised as follows. Section 2 describes the underwriting process. Section 3 describes in more detail the approach taken in other studies and our extensions to that approach. Section 4 describes the data and results. Section 5 describes some problems and possible extensions to our approach while Section 6 concludes.

2. Rights Issues in the United Kingdom

When a firm is planning a rights issue it will normally use an issuing house (usually a merchant bank) and a broker. As well as preparing offer documents and advising on the timing and the price of the offer, the issuing house will usually act as lead underwriter. The broker acts as agent for the issuing house by allocating sub-underwriting to other institutions (typically insurance companies, pension funds and banks).

Timing does vary, but normally the issuing house and broker will agree the issue price with the firm at a pricing meeting held at close of business on the day before 'impact day' . Following this the issue is announced and (typically) the rights are allotted to shareholders. At this point the issuing house will also sign the lead underwriting agreement in which it guarantees to buy any part of the issue that is not taken up at the agreed price. The issuing house then instructs the broker to arrange sub-underwriting for some or all of the issue (normally all). The broker sends out letters of invitation at 9am on impact day, giving the sub-underwriters a few hours to respond (typically by midday). The sub-underwriters are given a 'take it or leave it' offer based on the terms arranged by the issuing house. The number of sub-underwriters is usually quite large with 100-150 for small offers and 300-400 for large ones. Shareholders are usually given three to six weeks to take up their rights, with the underwriters obliged to take up any remaining shares that cannot be placed at the end of that period (the 'stick').

Underwriting fees are a flat 2% of the offer (though lower fees have been negotiated for privatisations). Of this 0.5% goes to the issuing house, 0.25% to the broker and 1.25% to the sub-underwriters. If the period of the issue exceeds thirty days both the underwriter's and sub-underwriters' fees are increased by 0.125% per week.

3. Valuing sub-underwriting

As was noted in the introduction, the fact that the fee structure is fixed and not normally negotiable has led some to argue that

underwriting is over-priced.[1] In particular the Office of Fair Trading (who commissioned Marsh's 1994 study described below) have concluded that, although underwriting is not explicitly anti-competitive, it may be a market in which competition is ineffective. They have urged corparates to re-assess their issuance techniques. The idea that underwriting is not competitive has also been suggested by Ritter (1984) as a reason for underpricing of issues in the US.

Given that the sub-underwriters are not involved in supplying advice or other services to the firm, they provide a relatively simple means of testing whether the fees received are excessive by establishing if the fee is equivalent to the economic cost of the insurance they provide.

Table A: Previous studies on the returns to sub-underwriting

Author	Country	No. of firms	Period	Estimated excess return (as % of fee in brackets)
Brealey (1971)	UK	50	1969	0.35% (30%)
Marsh (1980)	UK	539	1962-75	0.67% (50%)
Marsh (1994)	UK	691	1986-93	1.23% (86%)
Marsh (1980)	US	47		1.08% (99%)
MacCulloch & Emanuel (1993)	New Zealand	86	1976-84	0.67% (89%)
Kunimura & Iihara (1985)	Japan	148	1978-80	1.89% (76%)

[1]This raises the question of why other issuance techniques such as deep discounting are not used. This question parallels the rights offer paradox in the United States where firms seem to choose the most expensive issue method (see, for example, Eckbo and Masulis (1992) .

Although there have been a number of studies of the returns to sub-underwriting (see Table A), the most important in the UK context is Marsh (1994) (which is itself an extension of Marsh (1980)). This paper estimates the value of sub-underwriting by finding the value of the put option implicit in the underwriting agreement. The paper takes a sample of 691 underwritten issues between 1986 and 1993 and estimates the value of the put option in each case using the standard Black and Scholes (B&S) formula adjusted - using a method suggested by Smith (1977) - to take account of the change in the value of the firm and the number of shares when the new shares are issued. This adjustment allows for two effects: first, the increase in the value of the firm as a result of funds received from the rights issue; second, the dilution in the value of existing shares caused by issuing new shares at a lower price. In this case, αV is substituted for the share price and $(1-\alpha)C$ for the exercise price in the B&S formulation, so that the value of the call option (c) is given by

$$c = \alpha V \cdot N(d_1) - (1-\alpha)C \cdot e^{-r \cdot t} N(d_2)$$

$N(d)$ = The cumulative normal density function

$$d_1 = \frac{\log_e (\alpha V/(1-\alpha)C) + \left(r + \tfrac{1}{2}\sigma^2\right)t}{\sigma\sqrt{t}}$$

$$d_2 = \frac{\log_e (\alpha V/(1-\alpha)C) + \left(r - \tfrac{1}{2}\sigma^2\right)t}{\sigma\sqrt{t}}$$

The price of the put (u) is then given by the put-call parity condition

$$u = c - \alpha V + (1-\alpha)C \cdot e^{-rt}$$

where V is the value of the firm's equity prior to the issue, C is the proceeds to the firm of the rights issue and α is the number of new shares as a proportion of the number of new and old shares if all the rights are exercised. Marsh used the (mid-quote) closing stock price on the day before the beginning of the agreement as the spot price when calculating V and the issue offer price as the strike price (C). The 90-day Treasury bill rate was used as the risk-free interest rate (r) and the historic variance (over a sixty month period prior to the issue) of the share price as an estimate of the variance of its rate of return (σ^2) while the time to maturity of the option (t) was taken to be the difference between the start date of the underwriting agreement and the last acceptance day.

Comparing the price of this put with the fees actually received by sub-underwriters, Marsh estimated that sub-underwriters earned an average excess return of 1.23% on fees of 1.43% in his sample (ie 86% of the fee charged was abnormal return).

As well as this *ex-ante* measure of the profitability of sub-underwriting, Marsh also calculates an *ex-post* measure based on comparing the fee income received with the mean loss from taking up unsubscribed shares. On the basis of this approach, the mean abnormal return across the sample was 0.74% (1.24% if the 1987 crash is excluded).

Implicit in Marsh's approach (and the approach used in other studies) is that the only cost facing sub-underwriters is the cost of the put option as valued using the B&S approach. In practice a sub-underwriter may face other costs:

1) Transactions costs. If we assume that a sub-underwriter has chosen to fully hedge her exposure (which is implicit in using an option valuation approach), then it is clear that, in practice, the cost of hedging will be increased above the simple B&S formula by the transactions costs involved in creating and adjusting the hedge. As well as this, although the sub-underwriting process appears to involve little direct cost, with underwriters forced to make a decision on the deal within a few hours, there may be longer-term direct costs. In particular, potential sub-underwriters may need to invest in research on a large number of firms prior to a rights issue so as to be in a position to make a decision should an issue occur.

2) Risk and the cost of capital. Even if sub-underwriters do maintain a hedge, they will face some risk since it is practically impossible to create a hedge that is continuously perfect, particularly in the face of potential credit risk. Added to this, the possibility of a non-normal distribution of share price movements such as the presence of excess kurtosis or time-varying variances means that even the theoretically perfect B&S hedge may not be sufficient to remove all risk. There is clearly a cost to taking such a risk, both implicitly in relation to the sub-underwriters' risk aversion and in some cases explicitly in the cost of regulatory capital. If the underwriting guarantee is taken up then the 'stick' is - for banks at least - treated as an ordinary share holding, attracting a 100% risk asset weighting (other investment firms face similar requirements). Where the shares are those of another bank, the cost of the entire holding

has to be deducted from capital unless explicit permission is obtained from the Bank of England.

3) Adverse selection costs. Rock (1986) and others have suggested that asymmetric information may have an important role to play in issuance and, in particular, may cause underpricing. Although these arguments are usually applied to the relationship between the firm and the rest of the market, it could just as easily apply to the relationship between sub-underwriters. When a potential sub-underwriter is faced with the decision of whether to accept an underwriting commitment he or she will have to assess if the business is being offered simply because more informed market participants have turned it down. Since the issuing house will tend to lay off all its underwriting commitment, its participation in the issue cannot be used as a indication either. Bearing this in mind, the issuing house may have to make the terms of the issue somewhat more attractive to compensate sub-underwriters for the potential winners' curse (that is, the risk of paying too much for the new shares).

These three effects may mean that both *ex-ante* and *ex-post* measures of return may overstate the abnormal return from sub-underwriting. In this paper we attempt to allow for these costs by using the assumption that the costs faced by sub-underwriters are similar to those faced by market-makers in the traded option market. Models of market microstructure have established that market-makers face three costs: the cost of holding inventory (and, in the options market, hedging), the cost of dealing with informed traders and the direct costs of maintaining a market-making presence (labour, capital etc). We should note however that there are a number of reasons to expect that the costs faced by market-makers are higher than those of sub-underwriters: the direct costs of market-making

are higher than those of sub-underwriters since market-makers must maintain a continuous presence in the market; the regulatory requirements faced by market-makers are more onerous (banks face 100% risk asset weighting for the full life of the option); and problems of adverse selection are likely to be greater since there is less opportunity to build long term, reputation-based, relationships with customers in the traded option market than between lead underwriters and sub-underwriters. Despite these differences, a comparison between the cost of purchasing a put option directly in the traded option market is likely to be a more appropriate measure of the cost of sub-underwriting than ignoring all such costs. This approach is similar to that of Phillips and Smith (1980), who assessed a number of apparent market anomalies in the light of transactions costs in the traded option market.

4. Data and Results

This study is based on the subset of rights issues between 1986 and end-November 1994 made by firms for which options were traded on LIFFE. This gives only a relatively small sample of 31 issues worth a total of £10.3 billion. However, using Marsh's method, we found that the value-weighted excess return on our sample was 91%, similar to the 86% found by Marsh for a sample of 691.[2] This gives us some confidence that our adjustments to Marsh's method are not severely distorted by small sample problems.

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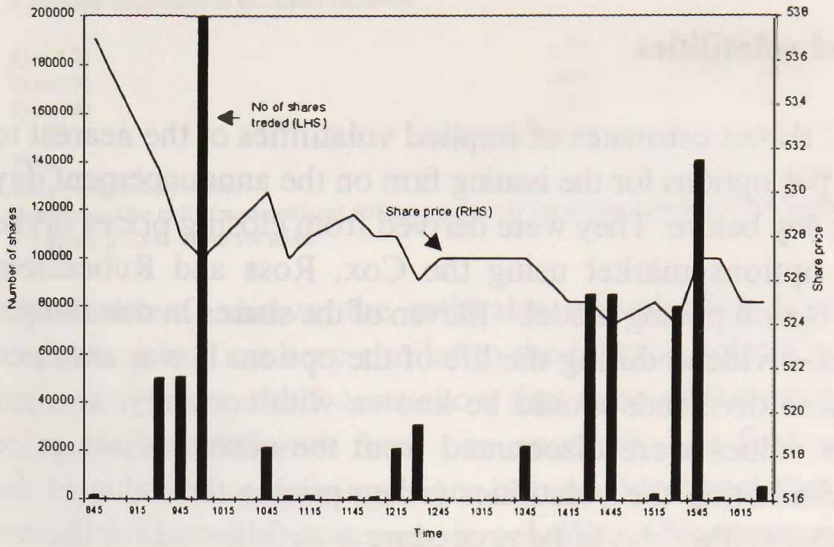
[2]Of the 31 issues included, two do not appear in the sample of rights issues used by Marsh while a further three occurred after the end of Marsh's sample period. It is also worth noting that the average value of the issues included in the present study is £332 million, compared to the average in Marsh's study of £20 million and that Marsh found larger issues to have higher abnormal profits.

Our first adjustment to Marsh's approach is to allow for the effect of the fall in a firm's share price that occurs when a rights announcement is made. Marsh uses the share price prevailing at close of business on the day the issue is announced and then adjusts for the rights effect through the method described above. However, as Table B shows, the value of the firm's shares on announcement day will usually change by more than that simple adjustment would predict. This is probably because of the signalling effect of a rights issue. Since the sub-underwriters do not sign the option contract until about midday on announcement day they will probably observe (or at least predict) this change before the sub-underwriting is agreed. To reflect this we use the share price on impact day itself thus allowing for the information effect of the offer as well as dilution.

Unfortunately, we have only been able to obtain high quality intra-day share price data from September 1994 onwards. As a result, we have not been able to use the share price actually prevailing at the time the implicit option contract is written (ie when the sub-underwriter agrees to underwrite - around midday). However, on the assumption that most of the price movement occurs immediately following the announcement (ie in the morning) we have used closing prices on the announcement day itself as a closer measure of the true change in p. Chart 1 shows the change in the share price during the announcement day for the only rights issue in our sample that occurred after September 1994 (Commercial Union). It shows that most of the fall in the share price (and a large proportion of the day's trading in that share) did occur during the first hour of trading on the announcement day. Table B presents some statistics on the pattern of share price movements during the course of the rights issue for our sample as a whole. It shows that there is a significant tendency for the price to fall on

announcement day and for that fall to be maintained over the whole issue period.

Chart 1: Intra-day share price on announcement day (Commercial Union 1994)



Share price is the price of the last trade in each fifteen minute period.

TABLE B: Change in share price during rights issue:

Change implied in dilution	Percentage change	Standard deviation
Average	-3.360	0.094
Smallest fall	-1.124	
Largest fall	-14.211	
Change between close of business on day before announcement day and close of business announcement day		
Average	-3.677	3.958
Largest gain	+2.25	
Largest fall	-16	
Change between close of business on day before announcement day and end of issue period		
Average	-4.465	7.86
Largest gain	+15.2	
Largest fall	-10.14	

Note: All issues weighted by value.

As well as this announcement day effect, the cost of put options in the traded option market can differ from the estimates made by Marsh in two ways: first, the estimate of volatility used in the option market may differ from those used by Marsh; second, market makers in the traded option market will charge a bid-ask spread.

Implied volatilities

Table C shows estimates of implied volatilities of the nearest to expiry[3] put options for the issuing firm on the announcement day and the day before. They were derived from closing prices in the traded options market using the Cox, Ross and Rubenstein (1979) option pricing model.[4] Eleven of the shares in our sample went ex-dividend during the life of the option. It was assumed that these dividends would be known with certainty, so their present values were discounted from the current share price when estimating the volatilities (when pricing the value of the sub-underwriting the same procedure was followed for the ten issues in which the new shares were not entitled to an outstanding or future dividend payment). On the day that the issue goes ex-rights, LIFFE automatically alters the exercise price of the option and its lot size to compensate for the dilution effects of the issue. This means the offer should have no effect on the estimated implied volatilities.

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[3] Except where expiry would have occurred during or immediately after the end of the rights issue when the next nearest expiry date was used.

[4] LIFFE equity options are american options (ie can be exercised at any time) so the pricing formula is slightly different from B&S. The traded options market closes at 16.10 while the stock exchange shuts at 16.30. However, for consistency LIFFE collect the share price at 16.10 and it is these prices that we use in estimating the implied volatilities.

TABLE C: Alternative estimates of share price volatility

	Day before announcement	Day of announcement
1) Average historic volatility	31.25	31.25
2) Average implied at-the-money (ATM) volatility	32.29	31.67
3) Average implied volatility for put option with exercise price similar to the underwriting agreement	31.81	31.91
F -Test for differences in estimated variances		
1) and 2)	1.033	1.013
1) and 3)	1.012	1.021
2) and 3)	1.015	1.008

Notes:
Issues weighted by value.
Cannot reject the null of no significant difference in any of the variance estimates. The critical value of the F-statistic is 1.841 at the 5% level.

As Table C shows, the estimates of volatility from traded options prices are very similar to the historic volatility used by Marsh (in fact, the F-tests show that none of the estimates are statistically different from one another). At first sight this seems a little surprising, since one might expect that a rights issue would cause an increase in volatility. However, as Marsh found, share price volatility over the acceptance period is, if anything, lower than its historic average (perhaps because firms' time issues to occur during periods of stability or because the firm and its advisors try to ensure that any price-sensitive information is disclosed when the issue is announced rather than during the acceptance period).

Bid-Ask spreads

Any trader who wishes to buy underwriting protection through the option market must incur the expense of the bid-ask spread. Models of market microstructure have established that this spread is related to three costs faced by market-makers: the cost of holding inventory, the cost of dealing with informed traders (so that prices subsequently move against the

market-maker) and the direct costs of maintaining a market making presence (capital, labour etc). These costs conform closely to the cost of underwriting discussed above and so one might expect the bid-ask spread to be a good estimate of the costs faced by sub-underwriters. Data on bid-ask spreads in the traded option market are not available before September 1994, so we have used estimates of the spread for all the firms in our sample over October 1994 using closing spreads collected by LIFFE. The spread is measured for the nearest to expiry put option with an exercise price as close to the discount in the original issue.[5]

This gave an average spread of 1.57 pence which we used to value the sub-underwriting option at the offer price of the market maker. As well as the spread, traded option deals usually involve a commission of about 1.5% and a settlement levy of about £1.50 per contract. However, since neither of these charges go the market-maker, we have excluded them from our calculations.[6]

TABLE D: Estimated abnormal returns from sub-underwriting

	Abnormal return (expressed as a percentage)	
	Of value of issue	Of fee
Day before closing share price - (Marsh's method)		
Historic Volatility	1.137	91.0
Share price at end of launch day		
Historic volatility	0.929	74.3
Implied ATM volatility	0.869	69.5
Adjusted for bid-ask spread	0.494	39.5
Implied volatility nearest the offer price	0.868	69.4
Adjusted for bid-ask spread	0.493	39.4

[5]Where the exercise price of the underwriting contract lay between the exercise price of two traded options we interpolated the spread.

[6]These costs are analogous to the broking and lead underwriting fees charged in underwriting agreements.

Since our volatility estimates are similar to those used by Marsh, the main adjustment to Marsh's results comes through the bid-ask spread - though the use of closing prices on impact day also makes a significant contribution. Table D presents the results of our comparison of value weighted abnormal returns. Using Marsh's approach with the historic estimate of volatility and the share price the day before the issue's launch yields an implied abnormal return of 91.0% of the fee paid[7] - similar to Marsh's estimate of 86%. (The difference may reflect a size of issue effect, since Marsh found larger issues yielded a higher return for sub-underwriters.) Using the share price at the close of the launch day this return falls to 74.3% using the historic estimate of volatility or 69.5% using the implied ATM volatility estimate. Adjusting the abnormal return for the bid ask spread reduces this return even further giving a mean abnormal return of 39.5% of the fee or 0.5% of the total value of the issue - equivalent to £50.9 million[8] in implied returns.

5. Some Problems

Although measuring the cost of sub-underwriting by comparing it with the cost of a similar put option in the traded equity market is intuitively simple and appealing, there are a number of problems that make the comparison less straightforward than it appears.

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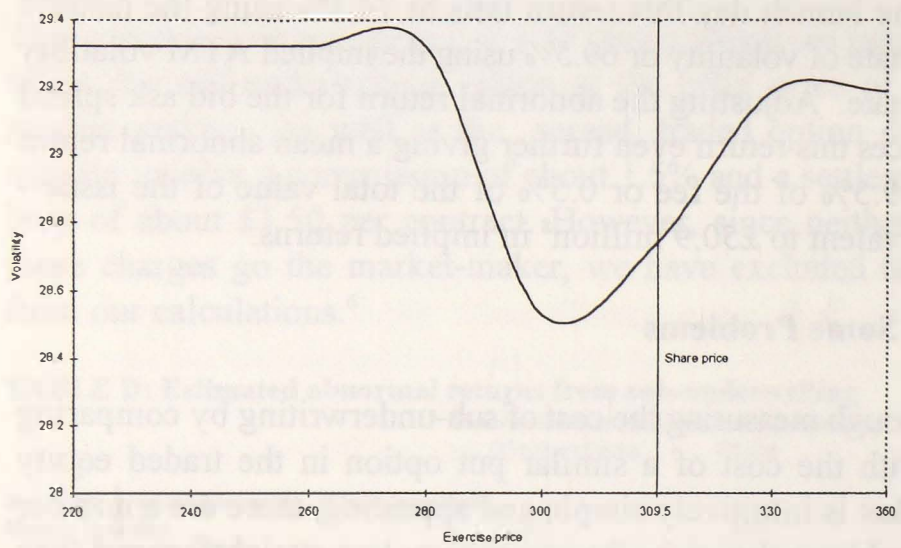
[7] All of the issues in our sample were of less than 30 days duration and therefore had sub-underwriting fees of 1.25%.

[8] Using the sub-sample of 26 issues included in the Marsh study has only a marginal effect on the implied return on sub-underwriting, with an implied abnormal return of 46.9% of the fee (or £49.7 million) using the implied ATM volatility compared to 39.5% using the full sample.

1) Volatility 'smiles'. Simple B&S option pricing suggests that the implied volatility of options of the same time to expiry should have the same implied volatility. In practice, the implied volatility appears to change according to the relationship between the current share price and the exercise price. An example of a smile curve for our data is shown in Chart 2.

Chart 2: The Implied Volatility 'Smile' Curve

(British Airways 21/5/93)



A number of explanations have been advanced for this effect, including non-normal distributions of asset returns and the effects of transaction costs (see, for example, Murphy (1994)). These smiles make the volatility comparisons between traded option and sub-underwriting problematic since they indicate that the B&S model does not provide an adequate representation of the relationship between volatility and option prices. Table D attempts to make some allowance for this effect by

using an estimate of implied volatility taken from options that are out-of-the-money to the same extent as the underwriting contract, but even this adjustment does not compensate for the fact that implied volatilities derived from the B&S model (and its binomial equivalents) may not give an exact estimate of true expected volatilities.[9]

2) Quoted spreads and realised spreads. A number of studies have found that the spreads at which transactions are actually undertaken are usually better than those quoted on market-makers screens in most market maker based markets (see for example Petersen and Fialkowski (1994) for evidence in the case of the New York Stock Exchange and Breedon (1992) for the London Stock Exchange). There is also some evidence that this occurs in the traded option market. Board and Sutcliffe (1995) estimate that realised spread are, on average, 10% less than the quoted spread in the UK traded options market (see Phillips and Roberts (1979) for US evidence). However, estimation of spreads from actual transactions data is fraught with difficulties since the estimated spread is highly sensitive to factors such as trade size. Also, since many studies have found that very large trades are more likely to be done near the quoted spread we felt that the quoted spread may be a fair estimate of the spread for underwriting.[10]

3) Sensitivity of the spread. Although we have attempted as far as possible to match underwriting terms with an actual option trading in the market, the options used have inevitably had somewhat different characteristics than the underwriting

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[9]Although the approach used is similar to that used by LIFFE to estimate volatilities.

[10]Although there are a large number of sub-underwriters, the fact that they all know that this is a large deal in total probably means that they will quote as if it was a large trade.

contract. In particular, the time to expiry of the traded option was often slightly longer than that of the underwriting contract. In order to evaluate the effect that these differences might have on the results we analysed the relationship between the size of the spread and the characteristics of the option through a simple regression of the spread on its characteristics. The sample used was data on all put contracts traded on one day (3 October 1994), a sample of 699 observations in all.

$$S = \sum \beta_i (FIRM_i) + \underset{(31.8)}{0.013\,(P-X)} + \underset{(6.5)}{0.096\,(MONTH)} + \underset{(3.2)}{0.003\,(P)} - \underset{(1.9)}{0.07\,(\sigma)}$$

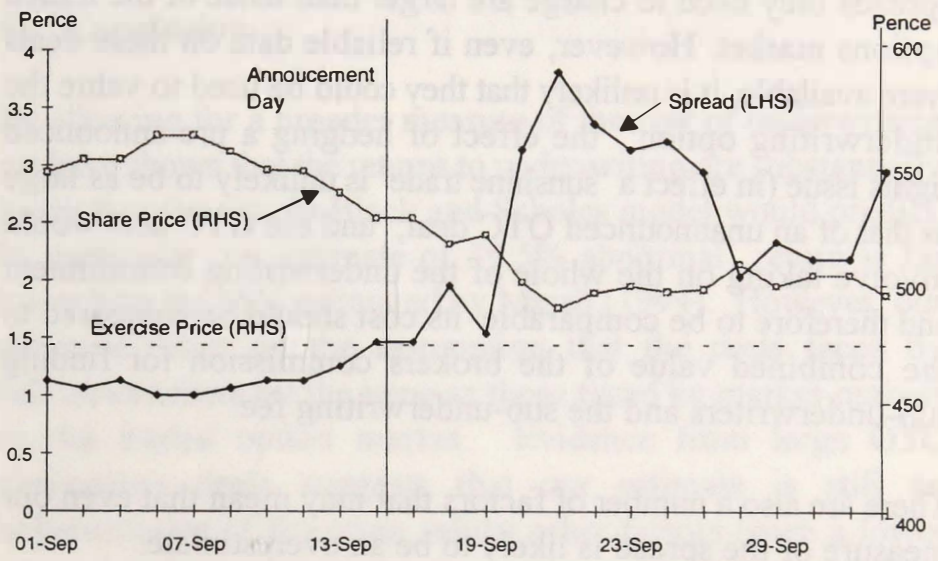
SPREAD = Bid-ask spread for a standard contract (£1,000 of underlying) in pounds
FIRM = Firm specific dummies[11]
P = Current Share price in pence
X = Exercise price of the option in pence
MONTH = months to expiry
σ = Implied volatility of the option
(t-statistics in parentheses)

As the regression shows, the spread is indeed sensitive to the characteristics of the option, particularly the difference between the share price and the exercise price (the intrinsic value). Fortunately, the range of exercise prices in the traded option market mean that we have been able to match the intrinsic value of the traded option quite closely with the value of the sub-underwriting. Although there is some effect from time to expiry this is quite small with an increase of one month only generating a 0.1 pence wider spread. Adjusting our measured spreads for the differences in characteristics (including volatility and changes in the level of the share price) using the parameters estimated above yields an average spread of 1.61 pence, similar to our initial estimate.

[11] Firm specific effects were significant in the regression with t-statistics of up to 4.7. Results available from the authors on request.

4) Changing spreads around new issues. Given that our measure of the spread in the traded options market is taken for a period different from that of when the actual issue occurred (data on spreads is only available back to September 1994), if spreads tend to widen coming up to an issue our measure will be an underestimate of the spread prevailing at the time of the underwriting contract. We investigated this by looking at traded option spreads surrounding the only rights issue in our sample that occurred after September 1994 (Commercial Union). As chart 3 shows, the announcement of a rights issue does not seem to have adversely effected spreads. Consistent with the regression above, the most significant determinant of the spread is the difference between the current share price and the exercise price of the option.

Chart 3: Option spreads around rights issues
(Commercial Union 1994)



5) Deal Size. Our estimates of the bid-ask spread are based on normal transactions in the traded option market which are far smaller than the size of the underwriting option in a rights issue. Therefore, to the extent that the spread increases in deal size, our measure of the bid-ask spread may underestimate the true cost of underwriting. Reliable data on large Over The Counter (OTC) options deals are not available and so a direct estimate of the cost of large option deals is not possible. However, our discussions with firms involved in such deals suggest that the pricing of such options is indeed different from smaller exchange-traded deals and that the spreads will be larger. Most firms involved in large OTC deals run Monte Carlo simulations of the cost of hedging based on actual transactions costs and some adjustment for the market impact of the large size of hedging operations required. They generally find that the spreads they need to charge are larger than those of the traded options market. However, even if reliable data on these deals were available, it is unlikely that they could be used to value the underwriting option: the effect of hedging a pre-announced rights issue (in effect a 'sunshine trade' is unlikely to be as large as that of an unannounced OTC deal; and the OTC deal would involve taking on the whole of the underwriting commitment and therefore to be comparable its cost should be compared to the combined value of the brokers commission for finding sub-underwriters and the sub-underwriting fee.

There are also a number of factors that may mean that even our measure of the spread is likely to be an overestimate.

(a) As discussed in Section 5.2, we have used quoted spreads rather than realised spreads and studies of other markets (eg Breedon (1992)) have found that, even for very large

deals, the realised spread is unlikely to be greater than the quoted spread.

(b) Models of spreads have found that deal size has two offsetting effects on the spread. First, large deals have a lower transactions cost per share and so the spread falls with trade size. Second, both inventory costs and the probability of the market moving against the market-maker after the trade is higher for large trades than for small ones. However, most studies have found inventory costs to be very small or insignificant (see for example De Jong *et al* (1994)). Also, in the case of a rights issue, the information effect may not be related to deal size since the adverse information effects that do occur (the winner's curse for ill-informed sub-underwriters) are unlikely to be related to the size of the issue.

6. Conclusion

By allowing for a broader measure of the cost of underwriting we have shown that the returns to underwriting are substantially lower than the simple Black and Scholes model would predict. In particular our estimate of 39.5% abnormal return is far lower than the 86% estimated by Marsh (1994). However, our estimate relies on the assumption that the costs faced by sub-underwriters are the same as those faced by market-makers in the traded option market. Evidence from large OTC derivatives deals suggests that our estimate is still an underestimate of the costs, whilst other factors (such a lower adverse information costs, lower transactions costs and the difference between quoted and realized spreads) suggest that we have in fact overestimated the true cost. On balance, we doubt that the pricing of large OTC deals is a more accurate

representation of the costs faced by sub-underwriters than is the pricing of traded options, which we feel could be an upper bound on the true cost of sub-underwriting. So the broad conclusion reached by Marsh, that there are currently abnormal returns to sub-underwriting in the United Kingdom, is probably robust.

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