When a broking house underwrites a share issue it discharges two different functions: a distribution function and an insurance function. The former relates to the broker’s knowledge of the legal and procedural details of share issues and to his close contact with a network of institutional and personal clients. The latter, on the other hand, relates to the risk that the issue will be undersubscribed. This paper focuses on this second aspect of the underwriting agreement.

In return for bearing the risk of undersubscription, the broking house receives a fee based on a percentage of the funds to be raised by the issue. There are three variables the broker has some freedom in setting: the underwriting fee percentage, the issue price, and the length of the subscription period. Holding the latter two constant, the question of how to set the underwriting fee percentage arises. Clearly, the higher this percentage, the higher is the fee the broker will receive and thus the higher is the likelihood that the fee will adequately reward the broker for taking on the risk of undersubscription. However, the probability of winning the contract diminishes with increases in the underwriting fee percentage. By the same token, the lower the percentage, the lower is the broker’s fee and the lower is the probability that the fee will provide sufficient compensation for risk-bearing, but the more likely becomes the possibility of obtaining the contract. Thus, it is of interest to compute the minimum acceptable underwriting fee percentage at which the broker is just indifferent between winning or losing the contract. From the broker’s point of view, a plausible criterion to employ for arriving at an acceptable underwriting fee percentage is the net present value investment index. According to this approach the fee percentage should be set so that the present value of the cash inflows and outflows arising from the contract is greater than or equal to zero. The higher the net present value, the more attractive the contract. When the net present value is equal to zero, the broker is indifferent between accepting or rejecting the contract. Accordingly, the value of the fee percentage at which the net present value equals zero defines the minimum acceptable percentage.

Let \( i \) symbolize the issue price, and \( c \), the percentage of the issue price which the broker receives as underwriting compensation. To simplify the presentation, the analysis will be conducted on a per share basis. The present is assumed to be the opening date of the issue, although other points in time may be set without changing the results in any way. Assuming that the underwriting fees are received at the closing date of the issue, the present value of the fee per share is

\[
ci \cdot (\exp(-rT))
\]
where \( r \) is the continuously compounded riskless rate-of-return and \( T \) is the subscription period's length, i.e., the time interval between the opening and closing dates of the issue. \( \text{Exp}(.) \) is the exponential function. The choice of a riskless discount rate assumes that there is no risk that the client firm will default on the fee payment.\(^3\) Since the broker writes a put option at the opening date of the issue, his "outlay" at that point of time may be interpreted at the value of the put. Thus, the net present value per share or NPV is

\[
\text{NPV} = c_i \left( \text{exp}(-rT) \right) \cdot p
\]

where \( p \) is the per share value of the put. The value of \( p \) may be based on a celebrated formula for the valuation of a European put option developed by Black and Scholes (1). Let \( v \) symbolize the broker's assessment of the intrinsic value of the share at the opening date of the issue and \( s \), his estimate of the volatility or standard deviation of value per share during the subscription period. Then a simple reinterpretation of the Black-Scholes put formula yields

\[
p = i \left( \text{exp}(-rT) \right) N(-x_2) - v N(-x_1)
\]

where

\[
x_1 = \frac{\ln(v/i) + rT + (s^2/2)}{s}
\]

and

\[
x_2 = \frac{\ln(v/i) + rT - (s^2/2)}{s}
\]

\( N(.) \) is the cumulative probability distribution function of the unit normal random variable while \( \ln(.) \) stands for the natural logarithm function.

Since we are interested in finding the minimum acceptable fee percentage, it is necessary to set the net present value equal to zero and then solve for \( c \). Substituting expression (2) into equation (1), constraining the latter to be equal to zero, and finally isolating \( c \), we obtain the following

\[
c = N(-x_2) \cdot \left( \frac{v}{i} \right) N(-x_1) / \text{exp}(-rT)
\]

The right-hand side of equation (3) supplies us with the minimum acceptable underwriting contract fee percentage. Observe that this minimum value is a function of three groups of variables: the underwriting contract terms (the issue price and the length of the subscription period), the characteristics of the shares to be issued (the intrinsic value of the share at the opening date of the issue and the volatility of this value during the subscription period) and the riskless interest rate which prevails during the subscription period.

Although equation (3) may appear formidable, it should be emphasized that this formula can be easily computed. The contract terms are directly observable while the riskless interest rate may be estimated by computing the yield-to-maturity on a Commonwealth Government bond or Treasury note which expires at approximately the same date as the contract. Brokers already make assessments of their client firms' intrinsic share values when they underwrite share issues. The only novel and, admittedly, troublesome variable to calculate is the share volatility figure. Tables of values of the standard normal probability distribution are available in most textbooks in basic statistics. The foregoing is all that is required to implement equation (3). The values of the different variables can be substituted into the right-hand side of equation (3) to derive the minimum acceptable fee percentage for the specific contract in question.

Alternatively, a computer program may be written to implement equation (3). One such program was written in the BASIC language. The program was used to generate minimum acceptable values of \( c \) for various intrinsic value-to-issue-price ratios, \( v/i \), and share volatilities. Table 1 assumes that the riskless rate is 10 percent and the subscription period is one month whereas table 2 assumes a 10 percent riskless rate and a subscription period of two months.\(^4\) For example, table 1 indicates that if the riskless rate is 10 percent, the subscription period is one month, the share's volatility is twenty cents, and the value-to-issue-price ratio is 1.1 (that is, the issue price is discounted by approximately 10 percent from the share's intrinsic value), then the minimum acceptable fee percentage is 4.0%. Values of \( c \) less than this will result in a negative net present value on the contract.

A perusal through tables 1 and 2 shows that the pattern of values agrees with one's a priori expectations. For example, the lower the value-to-issue price ratio i.e., the smaller the discount at which the issue price is set from the share's intrinsic worth at the start of the subscription period, the higher the
minimum acceptable underwriting fee. This is intuitively appealing as the smaller the
discount, the greater the probability of
undersubscription. Holding other things
constant, the greater the volatility, the larger
the minimum acceptable underwriting com-
misision. The intuition behind this is clear
for the larger the volatility, the greater the
risk-bearing function discharged by the
broker; this should induce a larger minimum
acceptable commission. Finally, the longer
the maturity of the contract, the higher is
the minimum acceptable commission. Again,
this agrees with one's intuition for, other
things equal, the longer the subscription
period, the greater is the uncertainty borne
by the broker.

There are other possible applications of the
approach given in this paper which we shall
only hint at here, leaving it to future papers
to address. Firstly since the broker's assess-
ments of the value of the share at the opening
date of the issue and the volatility of this
value during the subscription period are
subjective, he may want to conduct a
sensitivity analysis on equation (3) to gauge
the responsiveness of the minimum accept­
able fee percentage to changes in these
variables. And secondly, brokers are usually
given some leeway in setting the length of
the subscription period. To assist in arriving
at the length of this period, the sensitivity of
the net present value on the contract to
changes in T may be measured via equation
(1).

To summarize, this paper has examined the
insurance function of the share underwrite­
ing contract. It was shown that such a
contract may be interpreted as a European
put option. This interpretation allowed the
application of the Black-Scholes put pricing
formula to price the underwriting contract.
Given the objective of setting the net present
value of the contract greater than or equal to
zero, a formula for the minimum acceptable
contract fee percentage was derived.

Of course, it may be that share brokers have
criteria other than the net present value
index when they enter into such contracts.
For example, a broker may simply wish to
 accommodate a client of long standing.
He may use underwriting contracts as a
"loss leader", taking losses in this segment
of the business in the hope of attracting
clients and recouping such losses in other
more profitable areas, such as share-trading.

Finally, competitive conditions in the
broking industry may mandate that the
broker accept underwriting contract terms
less favourable than those implied by equa­
tion (3). Even in these cases, this paper
may still be of relevance for the minimum
acceptable fee percentage can be used as a
benchmark, serving to emphasize the devia­
tions of actual fee percentages. If these
discrepancies cannot be adequately explained
then perhaps a thorough review of the
broker's contract-setting procedure is in
order.

Table 1.
Minimum Acceptable Underwriting Commissions, in Percentages. Assumptions: riskless
rate = 10%, Subscription period = 1 month.

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<th>Value-to-issue-price ratios</th>
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<th>1.1</th>
<th>1.2</th>
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<td></td>
<td></td>
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<td>7.6</td>
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Table 2.
Minimum Acceptable Underwriting Commissions, in Percentages, Assumptions: riskless
rate = 10%, Subscription period = 2 months.

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<th>Value-to-issue-price ratios</th>
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<tbody>
<tr>
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Footnotes
1. Note that the client firm’s option to “put” its shares to the broking house is exercisable at only a single point in time in the future, the closing date of the issue. Thus, the put which the broker writes is of the European rather than American type, as the latter is exercisable at any time up to its expiration date.

2. The net present value criterion is explained in most textbooks in business finance.

3. This appears to be a reasonable assumption. The broker is always protected from defaults on the underwriting fee payment because all subscriptions for shares are channelled through him. Thus, he can ensure that the underwriting fees are deducted prior to forwarding the proceeds of the issue to the client firm.

4. More extensive tables and the computer program are freely available from the author upon request.

References

S.I.A. NEWS

NEW MEMBERS

NEW SOUTH WALES
Fellow
H. F. Bell
Associate
B. D. Fraser
Affiliates
C. J. Arms
R. A. Crawford
I. G. Hardy
G. R. Leighton
A. G. Loudon
R. E. B. Mews
J. M. Morpeth
C. F. Plumridge
J. C. Stewart
J. D. Tresidder
Subscriber
A. R. Dudley Smith

QUEENSLAND
Affiliates
J. A. D’Alton
D. R. Flynn
M. E. Sexton

VICTORIA
Affiliates
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G. J. Whitelaw

SOUTH AUSTRALIA
Associate
G. V. Day