

Short Sales Restrictions, Dilution and the Pricing of Rights Issues on the Singapore Stock Exchange

Publicly traded corporations seeking to raise new equity capital are faced with a number of possible financing vehicles. In addition to private placements, companies can also use secondary distributions (seasoned equity offerings) or rights issues (subscription warrants). Each of these alternatives features a somewhat different array of positive and negative elements. For a number of reasons, the appeal of the different elements is not homogenous resulting in significant geographical variation in the usage of the different financing techniques. For example, while there has been a "demise" of the rights issue on North American stock markets (Smith 1977; Heinkel and Schwartz 1986; Hansen 1988), the rights issue is popular on European and East Asian stock markets (Cai 1998; Stonham 1995).¹ Conventional valuations of rights issues model the rights as short dated warrants, e.g., Beglund and Wahlroos (1985), Bae and Levy (1994). This treatment permits the rights issue to be priced using an appropriately adjusted Black-Scholes model (Lauterbach and Schultz 1990). Consistent with results presented by Hietala (1994) for Finnish rights issues, this paper presents evidence indicating that such models are not applicable to rights issues traded on the Stock Exchange of Singapore (SES) where the bulk of rights issues have prices trading at or below the short arbitrage boundary. This pricing behaviour is attributed to the presence of short selling restrictions which prevent the execution of arbitrage trades aimed at exploiting the observed mispricing.

I. Rights Issues Mechanics

A rights issue is a short dated warrant distributed by a firm directly to existing shareholders on a pro rata basis. The warrant typically gives shareholders the right to acquire additional shares of common stock at an exercise price which is at a discount to the current market price. For shareholders not

wanting to obtain the additional shares, there is a trading period where the warrant can be sold. Sale of the warrant indicates that the shareholder is willing to accept the associated reduction in pro rata firm ownership. For the firm, there are a number of key decisions which have to be made in setting the terms of the rights issue. Included in these decisions are: the size of the allocation ratio; the exercise price discount to the current market price; the length of the rights trading period; the time period between the end of rights trading and the exercise date; whether the rights issue will be underwritten; and, the acceptability of other securities for exercise payment. Some of these decisions can be restricted by the stock exchange on which the common stock is traded. For example, the rights trading period and the allowable time between the end of rights trading and the exercise date often is subject to stock exchange rules.

Considerable attention has been given to the problem of setting the optimal discount of the rights exercise price to the current stock price, e.g, Eckbo and Masulis (1992), Patterson and Ursel (1993). In principle, the deeper the discount of the exercise price to the current stock price, the more valuable the right will be and the greater the probability that the rights issue will be fully subscribed, i.e., that all the rights will be exercised and the company will obtain the amount of new equity which is desired. However, the greater is the discount, the greater is the number of new shares which have to be issued to raise a given amount of money. Theoretically, this means that there is a direct relationship between the size of the discount and the dilution of the earnings per share (EPS). More precisely, unless the new equity is being used to fund assets which have an anticipated return which is proportionately higher than that on existing assets, then future EPS will vary inversely with the size of the discount due to the dilutive impact of the warrant exercise. Heinkel and Schwartz (1986) go somewhat further and predict that

larger discounts will be associated with larger downward adjustments in the current stock price. This follows because a deep discount conveys negative information to outside investors about the true value of the issue.

The size of the discount is also connected to the problem of deciding whether to have the rights issue underwritten and, if so, what the underwriting fees would be, e.g., Chan (1997), Bohren (1997). If the firm chooses to use a non-underwritten rights offering, the underwriting fees are avoided but the gross proceeds will not be assured. This provides an inducement toward larger discounts. By pursuing an underwritten offering, the firm avoids the problems associated with the common stock price falling below the exercise price on the expiration date. In an underwritten offering, there will be a *ceteris paribus* inverse relationship between the size of the discount and the underwriting fees being charged. In addition to the inability to secure the desired capital, the fallout from the exercise price being above the stock price at the exercise date includes numerous other negatives, such as a considerable loss of both firm reputation and shareholder confidence in management. In Singapore, the decision of whether to use an underwriter is generally left to the listed issuer, subject to stating the decision in the rights issue announcement and in its application to the SES. However, if the SES considers it necessary to protect the interest of public investors, the SES may require any given rights issue to be underwritten.

Rights are issued to shareholders in much the same way that dividends are paid. The company's record book is closed on a certain date, known as the record date or book closure date (BCD). All common shareholders appearing in the record book on that date receive rights. In practice, due to settlement lags shares are traded ex rights for a few days before the BCD. Anyone purchasing shares on or after the ex rights date is not entitled to receive the rights being distributed. Between the date that

the rights issue is announced and the ex rights date, the stock is said to trade cum rights, meaning that the common stock purchasers during that period are entitled to receive the rights. A few days after the BCD, the rights begin to trade as a separate entity. Trading of rights issues depends on an essential feature: the allocation ratio. While each share is entitled to receive one right, there is considerable variation in the number of rights required to purchase one share of stock. The ratio of the number of shares of stock to the number of new shares being issued through the rights offering is the allocation ratio.

To see the implications of the allocation ratio, assume that the firm seeks to acquire a given amount funds, such that:

$$Q = Xn + X\#N$$

where: Q is the target amount of funds to be raised by the rights issue; X is the rights exercise price; n is the number of new shares which will be issued if the warrants are exercised; N is the number of 'old shares' outstanding; and, # (= N/n) is the allocation ratio. It follows that the selection of a specific discount ($S_t - X$) is directly related to the choice of an allocation ratio. For example suppose a firm with a market value of equity equal to \$100 million (= $S_t N$), with 1 million shares outstanding (= N; $S_t = \$100$), wants to raise \$5 million (= Q). Using an allocation ratio of 10 to 1, # = 10, a discount of 50% is sufficient to raise the funds required. Setting the discount at 0%, the allocation ratio changes to 20 to 1. Another useful example is for a doubling of the \$100 million market capitalization. In this case, a discount of 50% involves an allocation ratio of 1 to 2, increasing the number of shares outstanding (N) to 3 million. This dilutes the implied value of the equity to $S_{t+1} = \$66.67 = (\$100 + \$100)/3$. A discount of 0% implies # is 1 to 1. This does not dilute the implied value of equity ($S_{t+1} =$

\$100). Another illustration is given in the Example below.

Example

Relationship between Q, $(S_t - X)$, #, and n^*

$S_t = \$100$	$N = 1 \text{ million}$	$Q = \$50 \text{ million}$
Discount = 50%	Discount = 25%	Discount = 0%
$X = 50$	$X = 75$	$X = 100$
$n = 1 \text{ million}$	$n = 666,666$	$n = 500,000$
# = 1 to 1	# = 3 to 2	# = 2 to 1
$S_{t+1} = \$75$	$S_{t+1} = \$90$	$S_{t+1} = \$100$

* Discount is calculated as $(S_t - X)/S_t$ and $S_{t+1} = \{(S_t N) + (X n)\}/(N + n)$.

This example illustrates the relationship between the discount, the amount of funds to be raised and the associated dilution in the stock price due to the rights issue.

II. Pricing of Rights Issues

There are four dates of particular importance for rights issue pricing. The first date is the rights issue announcement date. If the information about the rights issue has not previously been made public, this date has important implications for the real prospects of the firm. However, the anticipated dilution associated with the rights issue will not impact the stock price on this date. This stock price adjustment will occur on the ex rights date. This date is designated $t=0$. All other things equal, the difference in the stock price on the announcement date and the ex date is a crude measure of the dilutive impact of the right issue on the stock price. The next important date is the rights expiration date. This date is designated $t=T$. On this date the stock must be purchased at the exercise price, or the right will expire worthless. For arbitrageurs and speculators, exercising requires a cash purchase of shares which must then be sold. This leads to the final date of interest, the listing date. On this date the new shares will be

eligible for sale on the stock exchange and profits from trading strategies can be realized.

A. Arbitrage Boundaries

The arbitrage boundary for a rights price, during the ex rights trading period ($0 \leq t \leq T$), of a right to purchase one share of common stock can be illustrated by considering the textbook decomposition of the rights price into intrinsic value and time value. More precisely, the price of a claim to purchase one share of stock is determined as:

$$P_t = (\#)R_t + (\#)IVR_t + \max[0, S_t - X] + (\#)TVR_t$$

where: P_t is the price at time t of a right to purchase one share of stock, where t applies to the ex rights trading period; R_t is the price of a single right which is distributed with each share of stock; $\#$ is allocation ratio, the number of rights required to subscribe to one share; TVR_t is the time value of the one right; IVR_t is the intrinsic value of one right; S_t is the ex rights stock price; and, X is the subscription or exercise price. In Singapore, trading practices on the SES quote prices for P_t , the right to purchase one share of stock, not R_t . Using this approach, the short arbitrage is profitable when $TVR < 0$. This is possible because the SES right is European, allowing the value of the right to trade below the immediate exercise value associated with IVR .

In Singapore, a SES rights issue is often referred to as a subscription warrant. This terminology is appropriate, as it captures the essential elements of the valuation problem. As a short dated warrant, a SES rights issue has an European feature.² The option is only exercisable at maturity. Due to the lag between the exercise date and the listing date, the SES right further requires the actual purchase of stock. The subscription feature is associated with the short dates on trading, exercise and settlement. This means that there is relatively little uncertainty about whether the warrant will be exercised. As

such, because the exercise price is at a discount to the current and expected future stock price, the SES right will almost always be exercised, making the dilutive impact of warrant exercise a relatively certain event. Hence, the market can anticipate the potential dilution and make appropriate adjustments to the stock price prior to the exercise date. In any event, the impact of dilution will not alter the arbitrage transactions which would bound the rights price. Given this, a fundamental feature of rights pricing on the SES is associated with the restriction on short sales of common stock. Except in very restrictive circumstances, short selling of stock on the SES is prohibited.³ By eliminating short arbitrage support, this restriction has important implications for the pricing of SES rights issues.

Rights issue prices on the SES tend to violate the lower arbitrage boundary. More precisely, if short sales are permitted, at $0 \neq t \neq T$ an arbitrageur could short the non-dividend paying stock at S_t , using a portion of the proceeds to purchase at P_t the right to purchase one share of stock at X ; and, putting the balance into a zero coupon bond earning r which matures on the exercise date.⁴ On the exercise date $t=T$, if $S_T < X$, then the right is left unexercised and the proceeds of the zero coupon bond are used to purchase stock at S_T which is delivered to settle the short position. If $S_T > X$, then the proceeds of the zero coupon bond are used to exercise the warrant and purchase the stock at X which is used to settle the short position once the stock is delivered. In a perfect market, the associated profit functions for these transactions are:

$$\text{If } S_T < X \text{ then } \delta = (S_t - P_t) \exp\{rt^*\} - S_T (> (S_t - P_t) \exp\{rt^*\} - X)$$

$$\text{If } S_T > X \text{ then } \delta = (S_t - P_t) \exp\{rt^*\} - X (> (S_t - P_t) \exp\{rt^*\} - S_T)$$

where: t^* is the fraction of the year remaining until the exercise date; T is the exercise date; and, S_T is the common stock price on the exercise date, if the warrants are exercised.⁵ Observing that absence of

arbitrage requires $\delta \neq 0$, these arbitrage profit functions can now be augmented by observing that all prices must be non-negative producing the short (the stock) arbitrage boundary:

$$P_t \geq \max[0, S_t - X \exp\{-rt^*\}] \quad (1)$$

Assuming $\exp\{-rt^*\} = 1$ due to both t^* and r being small, the short arbitrage boundary can be reduced to $P_t = \max[0, S_t - X]$ ($> \max[0, S_t - X \exp\{-rt^*\}]$). This theoretical relationship holds when direct consideration is given to the dilution associated with the rights issue.

B. Rights Issues and Dilution

Being a type of warrant, a rights issue raises the problem of potential dilution associated with warrant exercise. The difficulty this presents is apparent from the risk-neutral valuation model for the rights price:

$$P_t = e^{-rt} E\{ \max[S_T - X, 0] \} \quad (2)$$

The textbook approach to determining the impact of dilution on the common stock due to warrant exercise, e.g., Dubofsky (1992), was developed by Galai and Schneller (1978); by assuming perfect markets and an all equity financed firm, the common stock price is determined by the market value of the firm divided by the number of shares outstanding.⁶ The value per share of the firm on the exercise date if the warrants are exercised is obtained by evaluating: $V_T/(N + n) = S_T = (V_t + nX)/(N + n)$, where V_t is the market value of the firm's equity (= assets) after the warrants are issued but before warrant exercise, N is the number of 'old shares' outstanding and n is the number of new shares which will be issued if the warrants are exercised. Given that warrant exercise involves the sale of stock at a discount, there will be a dilution of the common stock. Evaluating the relevant Galai and Schneller stock prices at time t produces: $S_t = V_t/N > E[V_T]/(N+n) = E[S_T]$. This approach assumes that the ex rights stock price does not adjust to reflect the dilution implied by the rights issue.

In practice, there are a number of points which have to be addressed in applying the Galai and Schneller pricing model to Singapore rights prices. In particular, from (2) it is apparent that warrant exercise depends on the dilution-adjusted stock price, S_T . Yet, (1) has the intrinsic value of the right depending on S_t . For rational valuation of short dated warrants, the stock price during the pre-exercise ex rights trading period is required to reflect the potential dilution of warrant exercise. Yet, Galai and Schneller are concerned with long dated warrants which require adjustment for the possibility of material changes to the stock during the period leading up to warrant exercise. Because SES rights issues have a short time between trading the right and exercising the right, it can be assumed that S_t captures the potential dilution of the warrant exercise. The impact of dilution on S_t for the shareholder has been offset in the rights distribution. The shareholder has received compensation for the dilution in the form of a pro rata claim, R_t , to purchase new shares at a discount. The rights price determines a market value for the impact of dilution on a share of common stock. Because rights purchasers will be exercising claims to purchase new shares, rational valuation requires the dilutive impact of warrant exercise on the stock price to be taken into account in setting P_t . This leads to a different model of ex rights stock prices than that proposed by Galai and Schneller.

More precisely, assume there are two dates of interest: t which corresponds to both the announcement date and the ex rights date; and, T which corresponds to the expiration and listing dates. Let S_t^* be the cum rights stock price the instant prior to the ex rights date. It follows that $S_t^* = S_t + R_t$, because the rights issue redistributes the original ownership claim into the new ex rights share price, S_t , and the ownership claim associated with the dilution, R_t . If S_t correctly anticipates the certain dilution in S_T then $S_t = (V_t + Xn)/(N+n)$, while $S_t^* = V_t/N$. The S_t^* is used to denote the difference with Galai and Schneller where S_t

does not reflect dilution; for S_T dilution is only relevant if the warrants are exercised. In the present case, because the SES right is short dated in practice, with X at a significant discount to S_t^* and S_t , it is possible to assume that exercise is theoretically certain. Hence, S_t can be assumed to fully reflect the dilution associated with rights issue exercise. In addition, because the rights issue is distributed at no charge to shareholders, there is no change in the asset base due to cash flows from the sale of rights by the firm.

From this it is possible to solve for P_t :

$$S_t^c = S_t + R_t \quad \text{and} \quad \frac{V_t}{N} = \frac{V_t + Xn}{N + n} + R_t \quad \text{and} \quad (V_t + NX) \frac{n}{N + n} = NR_t$$

The allocation ratio, $\#$, can now be used to define the relationship between n and N as: $n = N/\#$. Using this substitution for n and imposing the additional restriction that $P_t \geq 0$ produces:⁷

$$P_t = \max[0, (S_t^c + X)] \frac{\#}{(1 + \#)} + \max[0, (S_t + X)] \quad (3)$$

This perfect markets result confirms the predicted relationship between the rights price and the arbitrage boundary in (1). It follows that dilution can be measured by evaluating whether the allocation adjusted discount on the announcement date, $(S_t^* - X)/(\#/(1+\#))$, equals the discount observed on the ex rights date, $(S_t - X)$.

III. Rights Issues in Singapore

During the time period for the rights issues being sampled, there were three distinct stock market segments in Singapore: the Mainboard of the SES; the Stock Exchange of Singapore Dealing and Automated Quotation market (SESDAQ), similar to the NASDAQ in the US; and the Central Limit Order Board International, or CLOB, which operated as an OTC market for investors to trade foreign, primarily Malaysian, securities.⁸ The sample of rights issues being examined only uses issues done on the Mainboard

and SESDAQ. As illustrated in Table 1, the bulk of rights issues originate on the Mainboard. In addition to segregating by exchange of issue, Table 1 also segregates by sector and year. While the relative capitalizations of the various sectors changes over time, at the midpoint of the sample the Industrial and Commercial sector accounted for 63.5% of SES market capitalization, Finance 22.1%, Properties 9.2% and Hotels 3.4%.⁹ The twenty largest companies on the SES account for around two-thirds of market capitalization. The number and size of rights issues roughly correspond to the relative market capitalizations. As for the distribution by year, there is a substantial dropoff in rights issues in 1998, consistent with the poor market conditions following the 1997 Asian financial crisis. Across time, SESDAQ issues appear to be particularly sensitive to market conditions.

The listing process for rights issues in Singapore is governed by the SES Listing Manual (see Appendix 1). The process begins when a Company decides to make a rights issue. At this point the Company can either make a public or a confidential application to the Exchange for approval of the rights issue. Concern about underwriting exposure is one rationale for making a confidential application. If the application is made confidentially, the listed issuer is expected to announce the issue promptly after the approval of the SES has been obtained.¹⁰ In addition, if there has been a leakage of information about a confidential submission, the listed Company is expected to make an appropriate announcement. The application process proper involves submission to the SES of an additional listing application, together with relevant supporting documents.¹¹ Upon receipt of an application, the SES uses a number of factors to evaluate the application. These factors include: the rationale for the issue; whether the Company has been complying fully with listing requirements; whether the Company has acted in good faith in relation to the current and any past applications; whether the details of the expected use of funds have been disclosed in the

prospectus and circular to shareholders; and, whether the terms of the rights issue entitle the shareholders to sell the right to a third party or revoke the right if the terms are not favourable at the time of exercise.

Once approval has been obtained from the SES, the Company is required to seek shareholder approval for the rights issue. This is done by issuing a circular, which includes notice of an Extraordinary General Meeting, together with a proxy form. Once approval of shareholders has been obtained, the Company will inform the SES of the Book Closure Date (BCD) and Entitlement Dates. The length of time from announcement of the rights issue to the setting of the BCD is usually around 2 months. Once the BCD is set a process is commenced which can vary slightly from issue to issue. A typical SES rights issue would proceed as follows: from the announcement date until seven days before the BCD the stock will trade cum-rights. Three calendar days following the BCD the Company issues the necessary rights documents, which include a Letter of Entitlement, Subsidiary Rights Application Form, and Provisional Allotment Letters.¹² On the following day after the documents are issued, rights trading will commence and continue for the next seven market days. Another seven market days after the close of rights trading, the Closing Date (CD) for acceptance and payment of the rights subscription is reached. No OTC or exchange trading of rights takes place in the period between the close of trading in the rights, acceptance and payment, and trading on the exchange. Two weeks following the CD the new shares will be listed under the existing counters. If the rights issue included special features such as long dated warrants, loan stock or 'A' shares, these will commence trading on a new listed counter two days after the start of trade on the underlying stock.

There are a number of distinctive features of SES rights issues, when compared to typical issues in Europe and North America. In particular, rights issues in Singapore are decidedly short dated.¹³ The trading period for rights is brief and the exercise date follows soon after the end of rights trading.

Combined with the need to set the exercise price at a discount to the expected stock price in order to ensure a successful issue, it follows that SES rights will have, at best, a small time premium, i.e, TVR_t will be close to zero.¹⁴ The incentive for purchasing a rights issue in order to speculate on an upward move in stock prices is further restricted by the need to settle by purchasing the stock. In addition to the transaction costs of purchasing the right, speculators will incur a further transaction cost when the stock is sold after exercise. All these institutional factors argue against the use of Black-Scholes option pricing methodologies to value rights traded on the SES, e.g., Lauterbach and Schultz (1990).¹⁵ Rather, the relevant valuation question is whether SES rights will obey the relevant arbitrage boundaries associated with European options, e.g., Halpern and Turnbull (1985), Hietala (1994). Even though SES rights issues are warrants and not CBOE-style options, the distinctive character of SES rights does avoid the "common errors in the valuation of warrants and options on firms with warrants" identified by Crouchy and Galai (1991).¹⁶

IV. Empirical Characteristics of the Rights Issues Sample

A. Construction of the Sample

The sample consists of SES rights issues from the Mainboard and SESDAQ from Jan. 1992 - Dec. 1998. A total of 98 rights issues were reported in the SES Fact Book for the sample period. For inclusion in the final sample, the following criteria were imposed: the rights issue had to be traded in Singapore dollars, this eliminated CLOB and Foreign Board issues; rights issues with combination features, such as the right to purchase stock plus long dated warrants or stock plus debt, were excluded; rights issues with inadequate data were excluded; and, rights issues which went ex-dividend between the announcement date and the exercise date were excluded. Of the 98 total issues, 52 met the criteria for inclusion. Table 2 provides details of the issues which were included in the sample. This Table contains the rights terms, the

exercise (subscription) price, the announcement date, the ex-date, the BCD and the rights trading period. The last column refers to the days for which there were prices for the rights traded. In some of the 1992-4 issues, even though there may have been more trading days permitted where trade actually took place, data limitations prevented all the days from being used. As such, this column may not match the information in Table 3 for number of market days traded.

The 52 rights issues produced a potential total of 530 closing prices.¹⁷ However, data problems during the 1992-4 period further reduced the number of closing prices to 413. Some of this paring of prices was a result of double checking which was done in assembling the sample. The original source for details and prices of the rights was the SES, Publication and Research Department, the SES Fact Book and the Straits Times. This information was cross checked using data from Datastream International. Where significant discrepancies were found, the observation for that date was dropped, instead of attempting reconciliation. Table 3 provides essential results from the final sample of rights issues. Consider the relationship between the allocation ratio and the discount. To determine the potential dilution associated with a given discount, it is necessary to divide the discount by the allocation ratio. For example, a discount of 11.11% with an allocation ratio of 1 will have a larger dilutive impact on the price of common stock than a 66.35% discount with an allocation ratio of 10. As noted previously, because the SES rights price (P) is for the purchase of one share of common, the allocation ratio has already been captured in the rights price (P).

B. The Impact of Dilution

Taking the relationship between the allocation ratio and the associated dilution into account, a rough indicator of the dilutive impact of a rights issue on the stock price can be observed in the difference between the discount observed on the announcement date, $(S^* - X)$, and the discount on the ex date, $(S - X)$.

Assuming that information about the rights issue was not available prior to the announcement, (3) makes a precise prediction for a fall in the stock price, by the amount of the dilution, between the announcement and ex dates. In practice, there will be numerous factors which could contaminate this relationship for any given stock. For example, there is the usual day-to-day variation in stock prices driven by market conditions. Another possible factor is associated with the possibility that the announcement of the rights issue conveys positive information about future asset purchases and firm growth. Rights issue exercise involves a cash inflow to the company which is used to purchase new assets. Insofar as these assets have higher anticipated returns than existing assets, or permit higher returns to be earned on existing assets, then the rights issue will not be fully diluting.

The empirical evidence in Table 3 concerns the discounts on the announcement date and ex date. The discounts are expressed as percentages in order to control for variation in discounts across the range of stock prices, e.g., using price differences, high priced stocks with small percentage discounts would appear to have larger relative discounts compared to low priced stocks with high percentage discounts. In this case, arithmetic averaging of the price discounts could give misleading results. The use of percentages reverses this situation, permitting the arithmetic average to provide a more accurate indication of the average size of the discounts. However, the use of percentages does tend to give a larger relative impact to lower priced stocks, than to higher priced stocks. In addition, even with the correction of using percentages, there is still the absence of a connection between the allocation ratio and the size of the discount. Not adjusting by the allocation ratio means that the discounts apply to P_t , not R_t . Recognizing these potential limitations, examining just the average discounts on the two dates reveals a reduction in the discount of over 4%. Allowing for the affect of extreme values by using the median reveals a reduction of

7%, a value indicating that rights issues have only a partially dilutive impact on the stock price.

Reaching conclusions about dilution based on an examination of percentage discounts is only approximate. More precise calculations require evaluating whether the announcement and ex date discounts conform to the dilution adjustments identified in (3): $(S - X) = (S_t^* - R_t)(\#/(1+\#))$. Assuming that $S^* > S$, adapting (3) to percentages produces:

$$\frac{(S \& X)}{S} \cdot \frac{(S^c \& X)}{S} \frac{\#}{(1 \% \#)} > \frac{(S^c \& X)}{S^c} \frac{\#}{(1 \% \#)} \quad (4)$$

Interpreting whether the change in a particular discount represents a dilution is complicated by numerous factors. It is likely that cases of extreme values for the allocation adjusted discounts represent unusual cases which may contaminate the results. For example, an allocation ratio adjusted discount of 256% represents a substantial recapitalization of the firm which is almost certainly a special case with features much different than other rights issues. Cases with negative discounts may also have unusual features. Hence, a further adjustment can be made to the sample by eliminating observations which have percentage discounts greater than 100% and less than 0%. Eliminating the six observations which lie outside these boundaries produces a restricted sample which can also be used to evaluate (3) and (4).

The various relevant calculations are produced in Table 3A:

Table 3A

**Dilution Adjusted
Percentage Discounts for the Ex Rights Date
and Announcement Date**

	Full Sample	Restricted Sample
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Allocation Ratio = #	Average: 2.81 Median: 2.00	Average: 3.04 Median: 2.50
$(S - X)/S$	Average: 33.82% Median: 31.91%	Average: 33.55% Median: 31.82%
$(S^* - X)/S^*$	Average: 37.97% Median: 38.71%	Average: 38.83% Median: 38.17%
$(S^* - X)/S$	Average: 39.87% Median: 43.48%	Average: 42.18% Median: 42.10%
$\{(S^* - X)/S\} \{ \# / (1 + \#) \}$	Average: 29.38% Median: 28.98%	Average: 31.71% Median: 30.06%

Evaluating (3) confirms that the dilution associated with the rights issue is only partially reflected in the ex rights stock price. In other words, the impact of the issue of an individual right on S_t is value enhancing: $S_t + R_t > S_t^*$.

C. Violation of Arbitrage Boundaries

Table 4 presents results for violations of the short arbitrage condition for the sample of SES rights prices. The results in Table 4 are striking. Of the 413 SES rights prices examined, 360 represented violations of the short arbitrage condition, 91.1% of the total sample. This total includes 24 prices which were for out-of-the-money and at-the-money rights prices. The violations do not appear to be systematically related to moneyness. For example, 95% of the 0-20% in-the-money rights exhibited violations while 92.3% of the rights which were 50-60% in-the-money also violated the short arbitrage boundary. The violations appear consistently across all years of the sample. Table 5 reveals more detailed information about the specifics of the violations. Recognizing that the short arbitrage condition is derived under the assumption of perfect markets, Table 5 indicates the size of the violations needed for traders to incur the transactions costs associated with bid/offer spreads, commissions and the like needed to execute

the non-arbitrage trades aimed at exploiting the rights issue mispricing.¹⁸ Close inspection reveals that there are numerous cases where transactions costs, alone, cannot be the sole explanation for the observed deviation. For example, consider the Fraser and Neave rights issue which has a large discount on a stock with a sizable market value. Even though the violation percentage is not large at 5.5%, due to the high price for the right, the discount of almost 34 cents is difficult to attribute solely to transactions costs.

Transactions costs are an important consideration when examining violations of an arbitrage boundary (see Appendix 2). Even though execution of the short arbitrage is not possible due to SES rules, it is still possible for current holders of stock to sell stock in inventory and repurchase the stock by purchasing a rights issue. Hence, in addition to dealers, current shareholders and, where relevant, the rights issue underwriter will be other sources of market liquidity. Yet, the process for current holders of the common stock to sell the stock and simultaneously repurchase the stock by buying the rights issue is cumbersome and somewhat costly. More precisely, as market makers, dealers will quote the bid/offer and be holders of stock inventory. As such, it is also possible for the dealers to sell stock out of inventory, at the offer price, and simultaneously recover the inventory by purchasing rights, at the bid price. Because of this significant potential difference in transactions costs for exchange dealers and off-exchange traders, dealers will be the marginal trader for rights issues. Even though the ability of current shareholders to execute sales of stock with repurchases using rights will provide a lower bound on the amount that the rights price can fall below the arbitrage boundary, it is unlikely that this lower boundary will ever be reached in practice due to the more favourable transactions costs that dealers are able to obtain. As such, observed deviations below the short arbitrage boundary likely contain a component associated with dealer profits from market making in rights issues.

V. Short Sales Restrictions

Rights issues on the SES are designed to be an effective mechanism for listed companies to raise new equity capital. By marketing the secondary issue directly to existing shareholders, a rights issue is able to tap the most appropriate target market for new shares. For various reasons, some shareholders will not want to acquire additional common stock and will seek to sell the rights during the rights trading period between the BCD and the exercise date. Such attempts to sell rights will be significantly impacted by the specific characteristics of SES rights issues. In particular, the short trading period is a narrow window for obtaining a favourable price. Many likely buyers of such rights, i.e., current shareholders, are already on the sidelines, having obtained sufficient rights from the rights distribution to maintain pro rata claims. Foreign traders are typically restricted from taking a position in the underlying stock and are unwilling or unable to trade the rights. In the face of short selling restrictions which undermine the execution of possible arbitrage trades, market dealers are essential providers of liquidity for rights trading. Yet, dealers will require an appropriate discount in order to participate. The result is rights prices which typically trade below the theoretical short arbitrage boundary.

Similar to stock exchanges in other East Asian countries, the SES operates under a short selling restriction. Such restrictions have been in place from the inception of the stock exchange trading, when market liquidity was thin and prices were subject to manipulation. Despite the remarkable financial evolution of recent years, the SES has been slow to eliminate trading restrictions, such as those on short sales and foreign ownership. Yet, the arguments for maintaining such rules on the higher capitalization East Asian stock exchanges are being questioned, e.g., Fung and Draper (1999), Gay and Jung (1999). In the case of SES rights issues, short sale restrictions appear to result in pricing which favours market dealers

at the expense of shareholders. While elimination of short selling restrictions may deprive dealers of the direct profits on activities such as rights issue trading, there are other indirect trading opportunities introduced by eliminating short sales restrictions, such as commissions on securities lending, execution of arbitrage trades, and increased trading volumes. The potential problem of downward price pressure produced by the execution of the short arbitrage trade would be offset by the upward pressure of short covering. In addition, short sales would provide an additional return to holders of stock inventory involved in lending to short sellers. An interesting, if unresolved, market microstructure question is associated with determining the net gainers and losers in this process.

The results of this paper are applicable to the larger debate surrounding the effectiveness of short selling restrictions on high capitalization stock exchanges such as those in Korea, Singapore and Hong Kong. Focusing on market volatility, manipulation of prices, and downward price pressure facilitating bear runs on prices, the arguments in favour of short selling restrictions require scrutiny. In the present context, if the removal of short sales restrictions does result in more accurate pricing, there is likely to be a decrease in price volatility, not the increase typically proposed by advocates of short selling restrictions. In addition, the belief that short selling puts excessive downward pressure on prices can be questioned. Because the short sale involves the borrowing of securities, the downward pressure on prices from the sale is offset by the upward effect of the future repurchase required to settle the short. Perhaps the most important difficulty posed by short selling restrictions is the associated disincentives to derivative security trading, which can be severely impacted, as derivatives trading depends fundamentally on the execution of both short and long arbitrage trades for effective pricing. For example, where stock index futures trading is permitted in conjunction with short sales restrictions on the underlying stocks, e.g., as is the case for Hang Seng index

futures, significant mispricing associated with the inability to execute the short arbitrage is observed (Fung and Draper 1999). **VI. Conclusions**

Rights issues are a popular method of raising additional equity capital on East Asian and European stock markets. The specific characteristics of rights issues differ from exchange to exchange. In Singapore, rights issues are characterised by a short rights trading period combined with a short time between the ex rights date and the rights expiration date. This narrow trading window implies that SES rights prices will tend to trade close to the relevant arbitrage boundary. However, this paper provides empirical evidence that the prices of rights traded on the SES systematically violate the short arbitrage boundary. Such violations can be attributed to the presence of short sales restrictions on the SES which prevent the execution of the relevant arbitrage trades. In the absence of short sales, support for rights prices is provided by dealer rights trading activities. Even though it is possible for current institutional and retail holders of stock to sell stock out of inventory and repurchase the stock using the rights issue, the transactions costs involved in such activities are considerable compared to those incurred by SES market makers. Given that these dealers are better situated to execute such non-arbitrage trades at lower cost, the observed violations of the short arbitrage boundary provide indirect evidence on the profitability of SES dealers' rights issue trading activities.

This paper also provides some evidence on the dilutive impact of equity recapitalizations funded through warrant issues. More precisely, to what extent is the dilution associated with a rights issue reflected in the ex rights stock price? Textbook presentations of warrant valuation, e.g., Dubofsky (1992), adjust the current stock price to account for dilution while empirical work indicates that unadjusted stock prices appear to work better, e.g. Lauterbach and Schultz (1990). This sample of SES rights issues indicates that

dilution is partially, but not fully, reflected in ex rights stock prices. The impact of dilution is measured by comparing the exercise price discount on the announcement date, when the stock price does not reflect the dilutive impact, with the discount on the ex rights date, when the stock price is being traded without the detached warrant. However, some caution may be needed in generalizing this result to other situations involving dilution. Because the time period involved in the SES rights issue process is short, this empirical result may not apply to assessing the impact of dilution on stock prices where long dated warrants are involved.

APPENDIX 1

Typical Schedule for Rights Issues, As Outlined In the SES Listing Manual*

Company's Announcement of Proposed Rights Issue Application for Approval of Rights Issue from SES Approval of Rights Issue by Company Shareholders Announcement of Book Closure Date Cum-Rights Trading Begins Ex-Rights Trading Begins on the Ex-date	Less than 2 months
Book Closure Date (BCD)	Last Cum-Date + 7CD**
Dispatch of Rights Shares Application and Excess Rights Shares Application Form, Rights Prospectus and CDP letter to Depositor (1-2 weeks)	BCD + 3MD
Commencement of Rights Trading	BCD + 4MD
End of Rights Trading	BCD + 10MD
Closing Date of Acceptance and Payment of Rights Subscription	BCD + 16MD (C)
Crediting of Rights Shares, Dispatch of Refund Cheques and CDP Notification letters	C + 14CD
Listing of New Shares Under Existing Counters	C + 15CD
Listing of New Counter (i.e., for warrants, loan stock and A shares)	C + 17CD

* MD = Market Days; CD = Calendar Days.

** If this date is a holiday, the BCD for rights will fall on the following market day.

Appendix 2

Transactions Costs Levied by the Stock Exchange of Singapore

1. Brokerage Rates

The Stock Exchange of Singapore sets the following scales of brokerage payable by both Buyer and Seller for dealing in rights to a new issue in Singapore dollars:

Mainboard

Contract Value	Rate
On the first \$250,000	1.0%
On the next \$250,000	0.9%
On the next \$250,000	0.8%
On the next \$250,000	0.7%
On the next \$250,000	0.5%
On amounts exceeding \$1,500,000	Negotiable, subject to a minimum of 0.3%

The above are all subject to a minimum brokerage of S\$2 per contract.

2. Clearing Fees, Stamp Duties and GST

In addition to brokerage fees, the following charges are payable: a clearing fee of 0.05% on the value of the contract, subject to a maximum of S\$100; contract stamp duty of 0.05% on the value of the contract; transfer stamp duty of 0.2% on the value of the contract when the shares are sent for registration (transfer stamp duty is not payable for securities that are settled on a book entry basis); and, a Goods and Services Tax (GST) of 3% on brokerage and clearing fees.

TABLE 1: RIGHTS ISSUES IN SINGAPORE CLASSIFIED BY YEAR AND SECTOR (1992-1998)

	1992	1993	1994
Industrial	Jacks International Ltd. Superior Metal Printing Wing Tai Holdings Ltd. Tuan Sing Holdings Ltd. Gauthrie GTS Ltd. Jurong Engineering Ltd. Eu Yan Sang (LC Development) Ltd.	Fraser & Neave Ltd. Avlino Singapore Ltd. Van der Horst Ltd. Metro Holdings Ltd. Sembawang Maritime Ltd. CarnaudMetalbox Asia Ltd. Inno-Pacific Holdings Ltd. L&M Group Investments Ltd. Tonhew Industries (Asiamatrix) Ltd.	Wing Tai Holdings Ltd Cosco Investment Ltd Pacific Can Investment Holding Ltd. United Industrial Corp. Ltd. Steamers Maritime Holdings Jaya Holdings Ltd Tuan Sing Holdings Ltd SPP Ltd. Daimler-Benz
Finance	Keppel Finance Ltd. Tat Lee Bank Ltd. Singapore Finance Ltd. Overseas Union Trust Ltd. Overseas-Chinese Banking Corp. Ltd. Overseas Union Bank Ltd.	Tat Lee Bank Ltd. Industrial & Commercial Bank Ltd. Sing Investments & Finance Ltd. Singapore Building Society Ltd.	Focal Finance Ltd. United Overseas Bank Ltd. Overseas Union Bank Singapore Finance Ltd.
Hotels	Alliance Technology and Development Ltd.	Hotel Grand Central Ltd Apollo Enterprises Ltd.	King's Hotel Ltd (Republic Hotels & Resorts Ltd) Orchard Parade Holdings Ltd. Hotel Royal Ltd.
Properties		First Capital Corporation Ltd. Straits Steamship Land Ltd.	City Developments Ltd.
SESDAQ		Goldron Ltd.	Venture Manufacturing (Singapore) Ltd. Material Handling Engineering Ltd. Pan Pacific Publications Ltd. Heshe Holdings Ltd.
Total	14	18	21

Note:

- Summa Investment has changed name to Seapower Asia Investments Ltd on 7/2/94 and subsequently changed name to Pacific Century Regional Developments Ltd on 15/11/94.
- Eu Yan Sang has changed name to LC Developments on 16/9/93.
- Tonhew Industries has changed name to Asiamatrix Ltd on 13/6/94.
- King's hotel has changed name to Republic Hotel on 23/4/94.

TABLE 1 (Continued)

	1995	1996	1997	1998
Industrial	Jardome Strategic Hldgs Ltd. San The Ltd. Jack Chia MPPI Ltd. Lee Kim Tah Holdings Ltd. Cwt Distribution Ltd.	Liang Court Hldgs Ltd. Orchard Parade Hldgs Ltd. Provisions Suppliers Corpn Ltd. Econ International Ltd.	Oprey Maritime Ltd. Keppel Tele. & Tran Ltd. (Steamers Maritime Holdings Ltd.) Freight Links Express Hldgs Ltd. Electronic Resources Ltd. Lindereves-Jacobsberg Ltd. THBS Hldgs Ltd. Sembawang Resources Ltd. (Resources Development Corporation Ltd.) IPC Corpn Ltd. Nipponcraft Ltd.	Abt Holdings Ltd. C K Tang Ltd. Easyknit International Hldgs Ltd. Overseas Union Enterprise Ltd.
Finance	Tai Lee Finance Ltd. Tai Lee Bank Ltd.	Oversea-Chinese Banking Corp. Ltd. Singapore Finance Ltd. Overseas Union Trust Ltd. Singapore Reinsurance Corpn Ltd.	Pengkalan Investments Ltd. (Network Food International Ltd.) Overseas Union Bank Ltd. Tai Lee Bank Ltd.	Development Bank of Singapore.
Hotels	Hotel Grand Central	Pan Malayan Hldgs Ltd. (Tib Land Ltd.)		
Properties	Hal Sun Hup Grop Ltd. Aycenings Homes Ltd.			ST Capital Ltd.
SESDAQ	Inter-Roller Engng Ltd.	Vikay Industrial Ltd. Freight Links Express Hldgs Ltd. Melban Plastic Ltd. Venture Mfg (S) Ltd. Inter-Roller Engineering Ltd. Goldiron Ltd.	Plextech Hldgs Ltd.	
Total	11	15	13	6

Note:

5. Pengkalan Investments Ltd. has changed name to Network Food International Ltd. on 01/10/97.
6. Pan Malayan Holdings Ltd. has changed name to TLB Land Ltd. on 07/07/97.
7. Resources Development Corporation Ltd has changed name to Sembawang Resources Ltd. on 11/11/97.
8. Steamers Maritime Holdings Ltd. has changed name to Keppel Telecommunications and Transportation Ltd. on 03/03/97.

Source: the Stock Exchange of Singapore

TABLE 2: Details of the Sample of Singapore Rights Issues, 1992-8.

Company	Rights Terms	Subscription Price	Announce		Record Date	Rights Trading Period
			ment Date	Ex-Date		
Jacks International Ltd	2 for 1	1.00	2/1/92	1/8/92	20/1/92	21/01/92-22/01/92
Superior Metal Printing	3 for 2	0.31	1/6/92	12/6/92	18/6/92	24/06/92-10/07/92
Singapore Finance Ltd	1 for 2	1.10	5/6/92	22/6/92	2/7/92	03/07/92-04/07/92
Overseas Union Trust	1 for 2	1.50	8/11/92	19/8/92	29/8/92	31/08/92-01/09/92
Oversea-Chinese Banking Corp. Ltd	1 for 5	3.00	30/9/92	10/8/92	20/10/92	21/10/92-22/10/92
Wing Tai Holdings Ltd 1992	1 for 4	1.05	5/10/92	13/10/92	23/10/92	27/10/92-28/10/92
Overseas Union Bank Ltd	1 for 4	3.00	15/10/92	27/10/92	8/11/92	09/11/92-10/11/92
Gulthrie GTS Ltd	1 for 1	0.23	4/11/92	26/11/92	8/12/92	09/12/92-10/12/92
Jurong Engineering Limited	1 for 5	2.10	20/11/92	4/1 2/92	10/12/92	15/12/92-06/01/92
Alliance Technology and Dev. Ltd	3 for 5	1.00	17/1 1/92	10/12/92	22/12/92	23/12/92-24/12/92
Fraser & Neave Ltd	1 for 5	5.70	2/4/93	7/4/93	20/4/93	21/04/93-22/04/93
First Capital Corp. Ltd	1 for 4	2.00	3 1/5/93	16/6/93	22/6/93	25/08/93-15/07/93
Avimo Singapore Ltd	3 for 8	1.50	29/6/93	7/6/93	18/7/93	19/07/93-20/07/93
Metro Holdings Ltd	1 for 5	2.80	13/8/93	30/8/93	3/9/93	10/09/93-28/09/93
Tat Lee Bank Ltd	1 for 2	2.50	18/6/93	29/6/93	5/7/93	12/07/93-28/07/93
Hotel Grand Central Ltd	2 for 5	1.05	30/1 1/93	12/7/93	17/12/93	20/12/93-21/12/93
Inno-Pacific Holdings Ltd	5 for 2	0.27	21/10/93	11/4/93	10/11/93	16/11/93-03/12/93
Industrial & Commercial Bank Ltd	1 for 4	3.50	14/9/93	17/9/93	29/9/93	30/09/93-01/10/93
Sembawang Maritime Ltd	1 for 4	3.00	7/9/93	20/9/93	24/9/93	01/10/93-19/10/93
Wing Tai Holdings Ltd 1994	1 for 1	1.38	2/2/94	14/2/94	18/2/94	23/02/94-16/03/94
King's Hotel Ltd	2for5	1.75	17/2/94	22/2/94	4/3/94	07/03/94-08/03/94
Cosco Investment Limited	3 for 1	1.38	24/2/94	3/3/94	16/3/94	17/03/94-18/03/94
Focal Finance Ltd(OCBC Finance Lt	2 for 5	3.00	14/4/94	21/4/94	27/4/94	04/05/94-12/05/94
Hotel Royal Ltd	1 for 2	1.50	22/4/94	4/5/94	5/10/94	16/05/94-24/05/94
United Overseas Bank Ltd	1 for 10	3.50	5/5/94	20/5/94	26/5/94	01/06/94-09/06/94
City Developments 1994	1 for 5	2.90	9/6/94	20/6/94	18/07/94	30/06/94-08/07/94
Tuan Sing Holdings Ltd	1 for 1	0.48	14/10/94	21/10/94	21/11/94	03/11/94-11/11/94
PanPacific Publications Ltd	1 for 2	0.50	16/3/94	24/3/94	30/03/94	01/04/94-22/04/94
Hotel Grand Central	1 for 5	1.05	8/8/95	22/08/95	28/08/95	31/08/95-08/09/95
Hai Sun Hup Group Ltd	1 for 1	0.50	28/04/95	19/05/95	25/05/95	30/05/95-07/06/95
Goldtron Limited	1 for 5	0.79	14/10/96	22/10/96	28/10/96	31/10/96-08/11/96
Vikay Industrial Ltd	2 for 5	0.40	6/6/96	18/06/96	24/06/96	27/06/96-05/07/96
Tib And Ltd	3 for 2	2.00	30/05/96	6/12/96	18/06/96	21/08/96-01/07/96
Oversea-Chinese Banking Corp	1 for 10	3.00	24/05/96	6/12/96	18/06/96	21/06/96-01/07/96
Singapore Reinsurance Corp Ltd	1 for 2	1.30	17/06/96	25/06/96	7/1/96	04/07/96-12/07/96
Orchard Parade Holdings Ltd	1 for 1	1.80	23/08/96	9/2/96	9/6/96	11/09/96-19/09/96
Liang Court Holdings Limited	2 for 5	1.08	29/05/96	6/8/96	6/12/96	17/08/96-25/06/96
Singapore Finance Ltd	1 for 5	2.30	6/11/96	19/06/96	25/06/96	28/06/96-08/07/96
Venture MFG(S) Ltd	1 for 2	1.60	6/12/96	24/06/96	28/06/96	03/07/96-11/07/96
Econ International Ltd	1 for 2	1.22	20/11/96	12/5/96	12/11/96	16/12/96-30/12/96
Meiban Plastic Limited	2 for 5	0.38	13/06/96	20/06/96	26/06/96	01/07/96-09/07/96
Inter-Roller Engineering Ltd	1 for 2	0.35	23/10/96	11/1/96	11/7/96	13/11/96-21/11/96
Sembawang Resources Limited	1 for 1	2.40	28/10/97	11/11/97	17/11/97	20/11/97-28/11/97
Overseas Union Bank Ltd	1 for 5	4.00	5/12/97	6/5/97	6/11/97	16/06/97-24/06/97
Nippecraft Limited	3 for 4	0.11	12/11/97	18/12/97	24/12/97	30/12/97-08/01/98
Overseas Union Bank Ltd F	1 for 5	6.91	5/12/97	6/5/97	6/11/97	16/06/97-24/06/97
Osprey Maritime Ltd	1 for 1	1.45	18/06/97	27/06/97	7/3/97	08/07/97-16/07/97
Tibs Holdings Ltd	1 for 1	0.80	25/08/97	9/2/97	9/8/97	11/09/97-19/09/97
Abr Holdings Limited	2 for 1	0.25	15/12/98	23/12/98	29/12/98	04/01/99-12/01/99
C K Tang Ltd	2 for 1	0.22	27/10/98	11/10/98	16/11/98	19/11/98-27/11/98
Overseas Union Enterprise Ltd	2 for 5	2.75	08/05/98	12/05/98	18/05/98	21/05/98-29/05/98
ST Capital Limited	1 for 1	0.40	02/04/98	15/04/98	21/04/98	24/04/98-05/05/98
Development Bank of Singapore	1 for 5	6.00	20/03/98	30/03/98	03/04/98	09/04/98-20/04/98

Total: 52

TABLE 3: Announcement Date and Ex Date Discounts for Singapore Rights Issues

Company	Allocation Ratio	Market Days Traded	Discount at Announcement Date	Discount at Ex-Date
Jacks International Ltd	0.50	13	2.91%	3.85%
Superior Metal Printing	0.67	7	52.31%	36.08%
Singapore Finance Ltd	2.00	14	28.10%	21.43%
Overseas Union Trust	2.00	17	42.08%	31.82%
Oversea-Chinese Banking Corp. Ltd	5.00	13	68.91%	64.91%
Wing Tai Holdings Ltd 1992	4.00	13	25.00%	20.45%
Overseas Union Bank Ltd	4.00	15	35.90%	31.51%
Guthrie GTS Ltd	1.00	12	48.31%	42.50%
Jurong Engineering Limited	5.00	12	47.24%	46.15%
Alliance Technology and Dev. Ltd	1.67	13	-24.22%	-18.34%
Fraser & Neave Ltd	5.00	10	57.78%	54.76%
First Capital Corp. Ltd	4.00	13	51.69%	48.45%
Avimo Singapore Ltd	2.67	13	33.33%	29.25%
Metro Holdings Ltd	5.00	13	49.09%	47.66%
Tat Lee Bank Ltd	2.00	11	41.04%	25.15%
Hotel Grand Central Ltd	2.50	8	69.48%	50.93%
Inno-Pacific Holdings Ltd	0.40	13	75.52%	58.46%
Industrial & Commercial Bank Ltd	4.00	13	67.29%	30.69%
Sembawang Maritime Ltd	4.00	13	45.45%	47.37%
Wing Tai Holdings Ltd 1994	1.00	14	66.83%	54.00%
King's Hotel Ltd	2.50	10	56.47%	31.91%
Cosco Investment Limited	0.33	10	84.67%	67.91%
Focal Finance Ltd	2.50	13	19.35%	20.21%
Hotel Royal Ltd	2.00	13	48.28%	38.02%
United Overseas Bank Ltd	10.00	13	66.35%	66.02%
City Developments 1994	5.00	13	63.29%	57.97%
Tuan Sing Holdings Ltd	1.00	13	43.20%	27.27%
PanPacific Publications Ltd	2.00	13	66.44%	56.90%
Hotel Grand Central	5.00	7	35.58%	35.19%
Hai Sun Hup Group Ltd	1.00	7	41.18%	47.92%
Goldtron Limited	5.00	7	13.19%	15.96%
Vikay Industrial Ltd	2.50	7	38.46%	25.93%
Tib And Ltd	0.67	7	17.01%	9.91%
Oversea-Chinese Banking Corp	10.00	7	65.56%	65.03%
Singapore Reinsurance Corp Ltd	2.00	7	31.22%	27.78%
Orchard Parade Holdings Ltd	1.00	7	28.57%	28.85%
Liang Court Holdings Limited	2.50	7	13.60%	10.00%
Singapore Finance Ltd	5.00	7	4.17%	3.36%
Venture MFG(S) Ltd	2.00	7	38.22%	39.16%
Econ International Ltd	2.00	11	4.69%	1.61%
Meiban Plastic Limited	2.50	7	38.71%	36.67%
Inter-Roller Engineering Ltd	2.00	7	32.69%	33.96%
Sembawang Resources Limited	1.00	7	16.96%	7.34%
Overseas Union Bank Ltd	5.00	7	29.33%	25.23%
Nippecraft Limited	1.33	8	38.89%	18.18%
Overseas Union Bank Ltd F	5.00	7	31.45%	25.70%
Osprey Maritime Ltd	1.00	7	30.62%	20.33%
Tibs Holdings Ltd	1.00	7	38.93%	32.77%
Abr Holdings Limited	0.50	7	60.32%	60.32%
C K Tang Ltd	0.50	7	-10.00%	45.00%
Overseas Union Enterprise Ltd	2.50	7	0.00%	2.48%
ST Capital Limited	1.00	8	11.11%	52.38%
Development Bank of Singapore	5.00	8	29.74%	28.14%
Total:		530		

TABLE 3: (Cont'd) Summary Statistics for the Discounts

	Alloc. Ratio	Days Traded	Discount Ann. Date	Discount Ex Date
AVERAGE (1993-1998)	2.81	10.00	37.97%	33.82%
STDEV	2.15	3.02	0.23	0.19
MAX	10.00	17.00	85%	68%
MIN	0.33	7.00	-24%	-18%
MEDIAN	2.00	10.00	39%	32%

NOTES TO TABLE 3:

1. Allocation Ratio is the ratio of original shares to new shares sold through the rights issue.
2. Discount at time of announcement is calculated as the discount of the subscription price to the market price at the time of announcement.
3. Discount on the ex-date is calculated as the discount of the subscription price to the market price on ex-date.

Source: Stock Exchange of Singapore

Table 4: Violations of the Short Arbitrage Boundary by the Singapore Rights Prices Classified by Moneyness and by Year, 1992-98.

	1992	1993	1994	1995	1996	1997	1998	Total
	No. of Rights Prices							
Out-of-the-money:					10	3	7	20
At-the-money:					1	3		4
In-the-Money:								
0.00%-20%	14	7	15		42	16		74
Deep-in-the-money:								
20%-30%	33	8	7		15	14	8	75
30%-40%	29	4	7	14	13	7	5	78
40%-50%	7	16	6				3	32
50%-60%		33	25				7	65
60%-70%	13		7		7		7	34
Total								413

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	1992	1993	1994	1995	1996	1997	1998	Total	Violation %
	No. of Violations								
In-the-Money:									
0.00%-20%	14	7	15		37	16		74	17.9%
Deep-in-the-money:									
20%-30%	32	7	7		10	13	8	77	18.6%
30%-40%	27	4	6	14	13	7	5	76	18.4%
40%-50%	7	16	5				3	31	7.5%
50%-60%		29	24				7	60	14.5%
60%-70%	13		6		1		7	27	6.5%
Total								413	100%

TABLE 5: Violations of the Short Arbitrage Boundary by Singapore Rights Prices

Company	Actual Price	Boundary Value	Violation Percentage	Average Discount
Oversea-Chinese Banking Corp. Ltd	5.412	5.527	-2.10%	64.82%
Abr Holdings Limited	0.395	0.454	-13.09%	64.38%
Oversea-Chinese Banking Corp	5.836	5.344	10.01%	64.04%
United Overseas Bank Ltd	6.143	6.214	-2.10%	63.96%
PanPacific Publications Ltd	0.530	0.634	-16.60%	55.88%
Cosco Investment Limited	1.538	1.704	-9.30%	55.16%
Hotel Grand Central Ltd	1.067	1.208	-11.50%	53.42%
City Developments 1994	3.097	3.179	-2.40%	52.22%
ST Capital Limited	0.388	0.435	-11.67%	52.03%
Inno-Pacific Holdings Ltd	0.249	0.290	-14.30%	51.77%
Fraser & Neave Ltd	5.691	6.027	-5.50%	51.33%
Sembawang Maritime Ltd	2.927	3.167	-7.70%	51.31%
Wing Tai Holdings Ltd 1994	1.359	1.444	-6.00%	51.00%
Jurong Engineering Limited	1.980	2.034	-2.60%	49.20%
First Capital Corp. Ltd	1.616	1.186	-10.90%	47.57%
Metro Holdings Ltd	2.063	2.219	-6.90%	44.20%
Industrial & Commercial Bank Ltd	1.970	2.260	-12.80%	39.23%
Hai Sun Hup Group Ltd	0.274	0.321	-14.76%	39.09%
C K Tang Ltd	0.104	0.14	-26.09%	38.84%
Hotel Royal Ltd	0.844	0.886	-4.60%	37.12%
Guthrie GTS Ltd	0.087	0.123	-29.10%	34.81%
Overseas Union Bank Ltd	1.501	1.557	-3.50%	34.16%
Tibs Holdings Ltd	0.263	0.416	-37.18%	34.08%
Venture MFG(S) Ltd	0.437	0.803	-40.00%	33.25%
Meiban Plastic Limited	0.154	0.177	-12.91%	31.79%
Hotel Grand Central	0.431	0.481	-10.51%	31.41%
Wing Tai Holdings Ltd 1992	0.337	0.401	-15.90%	27.59%
Superior Metal Printing	0.098	0.112	-11.30%	26.49%
Overseas Union Trust	0.438	0.496	-11.60%	24.84%
Development Bank of Singapore	1.684	1.988	-14.97%	24.83%
Avimo Singapore Ltd	0.419	0.448	-5.70%	22.87%
Inter-Roller Engineering Ltd	0.041	0.101	-6.07%	22.38%
Osprey Maritime Ltd	0.334	0.414	-19.33%	22.13%
Overseas Union Bank Ltd F	1.784	1.869	-4.41%	21.27%
Focal Finance Ltd	0.414	0.791	-47.90%	20.87%
Singapore Reinsurance Corp Ltd	0.296	0.339	-12.42%	20.64%
Orchard Parade Holdings Ltd	1.254	0.467	173.21%	20.50%
Overseas Union Bank Ltd.	0.824	0.929	-11.36%	18.79%
Tat Lee Bank Ltd	0.447	0.543	-17.60%	17.82%
Tuan Sing Holdings Ltd	0.064	0.091	-30.30%	15.94%
Singapore Finance Ltd	0.149	0.197	-24.30%	15.19%
Vikay Industrial Ltd	0.029	0.05	-44.08%	11.02%
King's Hotel Ltd	0.091	0.208	-62.00%	10.39%
Goldtron Limited	0.031	0.067	-60.11%	7.78%
Nippcraft Limited	0.004	0.009	-70.00%	6.97%
Liang Court Holdings Limited	0.026	0.061	-59.77%	5.36%
Singapore Finance Ltd	0.010	0.04	-77.93%	2.53%

Tib And Ltd	n.a	0.046	n.a	2.22%
Sembawang Resources Limited*	0.004	-0.091	-87.50%	0.83%
Econ International Ltd*	0.007	-0.005	-16.67%	0.61%
Alliance Technology and Dev. Ltd	0.000	0.000	0.00%	0.00%
Overseas Union Enterprise Ltd	0.005	-0.47	n.a	-20.71%
Jacks International Ltd	0.010	0.010	0.00%	n.a

NOTES:

1. Actual Price is the average market rights prices observed for the duration of the rights trading period;
2. Boundary Value is the average value over the duration of the rights trading period.
3. Violation Percentage is arrived by (1) calculating the difference between the market price of the right and the model price of a right expressed as a percentage of the model price and (2) taking the average of each day's violation percentage during the rights trading period..
4. Average Discount is calculated by taking the average of the discount percentage value during the rights trading period.

*The calculations of violation and discount percentage for Econ Int'l and Sembawang Resources are based on in-the-money rights.

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**Short Sales Restrictions, Dilution and
the Pricing of Rights Issues
on the Singapore Stock Exchange**

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ABSTRACT

This paper presents evidence indicating that rights issues traded on the Stock Exchange of Singapore have prices trading at or below the short arbitrage boundary. This pricing behaviour is attributed to the presence of short selling restrictions which prevent the execution of arbitrage trades aimed at exploiting the observed mispricing. Evidence is also provided indicating that the anticipated dilution associated with the rights issue is only partially reflected in ex rights stock prices.

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NOTES

1. The trade press carries numerous articles on details of various rights offers in Europe and East Asia, e.g., Euroweek, June 12, 1998, "Daimler-Benz offers 20% discount in rights issue to raise DM7.5bn for merger" and Mar 6, 1998, "DBS in largest ever Singapore rights issue".
2. Warrant contracts are not standardized. In various locations, long dated warrants tend to have an American feature. In other locations, long dated warrants have a Bermuda feature or an European feature. For short dated warrants, there is limited probability of dividend payout on the underlying stock between the issue date and the exercise date. In this case, the American feature has no value and the European and American prices will be the same.
3. Two instances where short selling is permitted occur on sales for same day delivery and certain operations by listed companies trading their own stock.
4. For the SES rights prices, it is safely assumed that $S_t > X$.
5. The expectation $E[\cdot]$ is taken with respect to the risk neutral density.
6. Galai and Schneller are only interested in the impact of dilution in order to obtain the $\max[\cdot]$ function for warrant valuation.
7. The substitution for n gives: $(V-NX)((N/\#)/(N+(N/\#))) = NR$. The N 's in the multiplier with $\#$ now cancel to give: $(V-NX)((1/\#)/(1+(1/\#))) = NR$. Dividing through by N gives: $((V/N)-X)((1/\#)/(1+(1/\#)))=R$. Multiplying through by $\#$ and using the definition $P = \#R$ produces: $((V/N)-X)(1/(1+(1/\#)))=P$. The expression in the text now follows from observing that $1/(1+(1/\#))=\#/(1+\#)$. The last equality is solved by substituting the result that $S^*=S+R$ and manipulating.
8. Due to conflicts with the Kuala Lumpur Stock Exchange, the CLOB is no longer operational. There is also a small Foreign Board in Singapore which was established to allow the listing of foreign enterprises that are unable to meet the Mainboard's listing requirements. In addition to these stock exchanges, there is also a bond market and an illiquid equity options market trading a small number of stocks.
9. These values are taken from Euromoney, "Singapore, Asiamoney", Mar. 1994.
10. Further details are given in Practice Note 9e of the SES Listing Manual.
11. The additional listing application is to be prepared in compliance with Clause 816 of the Listing Manual. The supporting documents are identified in Clause 817.
12. As the bulk of trading on the SES is scripless, this step is transparent to the shareholders.
13. The length of the rights trading periods differs across locations. For example, Hietala (1994) reports that the rights trading period in Finland is 9 to 18 weeks.

14. Using Black-Scholes, it can be shown that, as the warrant goes further into the money, the price will converge to the intrinsic value. Hence, even without taking into account the impact of the short trading period, it is likely that the time value will be small because the terms of rights issues typically 15
 15. ~~With this exercise, it is clear that the use of an adjusted Black-Scholes option pricing model will give incorrect results.~~ Rather, the implication is that Black-Scholes is useful to price the time premium. As the option goes deep in- or out-of-the-money, Black-Scholes prices will converge to the arbitrage boundaries. Such boundaries can be identified without reference to Black-Scholes pricing methods.

16. Crouchy and Galai (1991) is primarily concerned with errors arising from the use of a dilution factor to adjust Black-Scholes prices in order to arrive at a market price for a warrant. For example, it is observed that: "Because warrants, given their implicit leverage, have a higher volatility than the assets of the firm, the volatility of the firm's equity is lower than the volatility of its assets". The implication is that volatility measures needed to price warrants may be underestimated if stock prices are used for the volatility input to Black-Scholes pricing. Such comments are not relevant to the present study, which is concerned with violations of arbitrage boundaries. One point which is raised by Crouchy and Galai which could have some relevance concerns the assumption of an all-equity financed firm to derive (3). The presence of warrants in the firm's capital structure alters the impact of the dilution factor in the Galai and Schneller model. The dilution factor required to adjust Black-Scholes prices is eliminated if the associated call option is for a firm with warrants. Yet, this is a consequence of Galai and Schneller not defining S_t to account for the potential dilution, which is only captured in S_T . Hence, this point is also not relevant. The "common errors in the valuation of warrants" have been avoided in the present analysis.

17. The total of 530 is from the sum of the market days traded in Table 3. Though high, low and close prices were available, only closing prices were used.

18. Data on bid/offer spreads, the most important component of transactions costs for rights issues, were not available. Data that is available on volume that is available indicates that rights issue trading is relatively thin. Given that traders other than SES market makers are almost certainly net sellers, it is likely that most trades are being done at the bid price.