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PROJECT PAPER

THE EFFICIENCY AND CHARACTERISTICS OF MALAYSIAN WARRANTS

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ABSTRACT

Warrants were first introduced on the KLSE in 1990. Since then, it has become a highly popular financial instrument amongst listed companies. However, there are some doubts about the maturity of the warrants market. There exist indications that investors may be ignorant of the behaviour of warrants and their pricing mechanism in relation to the more dominant underlying stocks and financial market.

This paper is intended to examine the efficiency of the local warrant market by primarily using the Black-Scholes Options Pricing Model. Analysis and tests were done on the theoretical time-value lower boundary of the warrants, mis-pricing, sensitivity to underlying stock price movements, and the correlation of warrant prices to other factors (e.g., time, market capitalization, volatility, and size of warrant issue). An examination was also done on the difference between mis-pricing of main board and second board warrants.

This study yielded rather mixed results on the efficiency of the local warrant market. There were some indications of efficiency, particularly with respect to the market's ability to absorb information relating to dilution, transaction costs, and underlying stock price. However, the market also displayed signs of inefficiency. Statistical tests based on factors such as the age, market performance, and mis-pricing levels between in-the-money and out-of-the-money produced results that were inconsistent with an efficient market. This has been found to be especially true for second board warrants.

1. INTRODUCTION

With the introduction of warrants on the KLSE in 1990, the local capital market was exposed to a derivative instrument for the first time. Warrants have many features that could be likened to a call option to the underlying stocks that are traded on the KLSE. Warrants or TSRs are basically instruments that allow the holders to purchase a certain amount of underlying stocks at a predetermined price prior to a fixed maturity date.

The first warrant issued in Malaysia was by Rashid Hussain Bhd on 28 May 1990. Such instruments were then known as Transferable Subscription Rights (TSRs). Since then warrants have become a popular fund raising tool for corporations which are embarking on new projects. From a corporation's stand point, warrants are attractive because they form part of the firm's equity and unlike debt, there is no fixed repayment schedule. They, however, do have an expiration date and unexercised warrants on maturity would result in the issuing company obtaining funding without having to increased its capital base. From an investor's point of view, investments in warrants could provide the opportunity of higher leverage since such instruments are cheaper than the underlying stocks.

The model for pricing of options could be based on the Black-Scholes Option Pricing Model (BSOPM). This model which was developed by Fischer Black and Myron Scholes (in collaboration with Robert Merton)[1] in the '70s has proven to be a robust and

[1] Robert Merton and Myron Scholes had been awarded the 1997 Nobel Prize for Economics for their work in the BSOPM

reliable model for estimating option prices[2]. Therefore the BSOPM could naturally be a viable model for valuing warrants. In fact, when the BSOPM was first developed, its principle innovators had used the model to value warrants to prove its practicality. However, Black and Scholes had also further elaborated on the problems that could be faced when valuing warrants based on the BSOPM formula. These problems arise due to some inherent differences between options and warrants.

There are a number of differences between options and warrants, particularly relating to dilution of the issuing company's share capital base, the originator of the transaction, and time to maturity. The major difference between options and warrants originates from the parties involved in the transactions. A single option transaction involves two investors, i.e., the buyer of an option purchases the right to buy a stock at a certain price by a certain date, while the seller will have to sell the stock if the option is exercised. The company whose stock forms the underlying asset for the option need not be involved in the transaction at all.

In the case of warrants, the initiator of the transaction is actually the corporation itself. The company concerned could be viewed as having sold a call option to the investors. Here, it is the company which agrees to sell a certain number of new stocks, at a certain price and by a certain date to its warrant holders when exercised. Therefore warrants

[2] The author of this paper has found that the pioneer paper on the BSOPM titled 'The Pricing of Options and Corporate Liabilities' as being one of the most referred research paper in the financial field. Practically every other single book or research paper in the area of options has quoted the original paper as reference

could not be treated exactly like options. This main contrast in feature precipitates into other differences in features between call options and warrants.

Black and Scholes (1973), noted that warrants normally have longer maturity periods than options. The life of options are usually denominated in months but warrants normally have maturity periods of several years. This is understandable since warrants are corporate securities and could in a certain sense, form part of the corporation's equity. The cost of issuing the warrants may be quite substantial and the company will want to ensure that the life span of the warrants are of medium duration. In Malaysia, warrants normally have life spans of between 4 to 5 years. Therefore during the long period of a warrant's tenor, various parameters (such as interest rates and volatility) that are used for the valuation of the warrants, which otherwise are normally assumed as constant, may change over time. This imposes an additional complexity to the conventional option pricing models, particularly the BSOPM. In addition, during the long period of maturity, various situations can occur which may impact some obvious static terms and conditions of the warrants. For example, the duration of the warrants, exercise price, and the number of shares that could be purchased by each warrant may change due to company restructuring or because of mergers and acquisitions but provisions are usually made in the warrant indentures for such eventualities.

The long life span of a warrant will also make dividend an important factor in its valuation. After all, in the few years of a warrant's life, the dividends paid out by the

company can have a significant impact on the price of the warrants. The dividend effect is quite negligible for options since they normally have short maturities.

Since warrants constitute a corporate equity, the company issuing the warrants could be viewed as having taken a short call position. As such, if indeed the warrants are exercised, the warrant issuer will have to sell a proportionate amount of shares to the warrant holders. This can be achieved by issuance of additional shares. The number of shares of the company may therefore be diluted if the warrants issued are exercised.

Emanuel (1983) further noted that warrants could be exercised early and therefore they have features that are like American options. Lauterbach and Schultz (1990) also recognised this problem and they rationalised that warrants will be only exercised early if there are expectations of huge dividends payments for the underlying stock. The problem of early exercise is practically non-existent if dividends are small.The warrant holders who are in a profitable position could easily sell off their warrants in the market, rather than exercising prior to maturity. Of course, certain other situations such as the restructuring of companies, and mergers and acquisitions may also prompt warrant holders to exercise before maturity. In addition, the difference in perception among investors may also prompt early exercise. The number of early exercises is however, assumed to be small.

This study is aimed at determining how efficient the local warrants market is. Section 2 of this paper would outline the reasons and objectives of this study. The modified

version of the BSOPM to value warrants will be described Section 3. Section 4 would detail the methodology and tests that would be carried out. The results and implications of the tests would be discussed in Section 5, while Section 6 serves to conclude and summarise the entire paper.

2. OBJECTIVE AND MOTIVATION FOR STUDY

While there are still a lot of mysticism surrounding the warrants market, it is generally acknowledged that warrants allow investors an alternative instrument that is highly correlated to the underlying stock with much lower transaction cost. As such, they can accord investors an opportunity to reap huge profits from favourable price movements. However, the naivety of local retail investors was evident when the expiration of out-of-the-money warrants such as MBF Holdings Bhd[3] and Aokam Perdana left a sour note among the investors. Investors were left disillusioned since their warrants had expired valueless and some quarters have even hinted that they were cheated by the issuing companies. This is of course, a phenomena that could be expected in derivative instruments as they may very well expire valueless and the investing public should be educated and be made aware of this possibility.

[1] MBf Holdings' TSRs were to expire out-of-the-money on 10 August 1996. The TSR holders were generally dissillusioned that the warrants had become worthless. MBf Holdings responded by appealing to the SC for extension of the warrants' tenor. This was subsequently rejected by the SC(New Straits Times, Business Section, p26, 12 July 1996).

Rashid Hussain Bhd had issued the first warrant in the country and this was followed by IOI Bhd in 1990. Within the next few years, warrants had become a popular tool for companies to raise cash. As of the end of August 1997, 116 warrants were issued by various corporations which are listed on the KLSE. Out of these, 13 of them have already expired as of the end of September 1997. Warrants issued by Malaysian companies are normally attached to bond issues as sweeteners.

The Securities Commission (SC) realises the importance of warrants to corporations and yet at the same time recognises that the rights of the investors have to be protected. Warrant issues could be subjected to manipulation since they are normally relatively small in size (as compared to the underlying stock base) and are cheaper than the underlying stocks. In ensuring this does not happen, the SC's guidelines clearly stipulate that warrants are only to be issued by viable and profitable companies which are intending to embark on projects with a gestation period. The liquidity of the underlying stock is also a criteria for companies seeking to issue warrants. The stocks of the company must have an average trading turnover of 12 million shares cumulative over the previous 12 months, and that there must be at least 2,000 registered share holders. The number of warrants that are to be issued must not exceed 50% of the issued share capital, and the maximum tenor for the warrants is 5 years. The SC also stipulates that the conversion ratio must be 1 to 1, i.e., each holder of a warrant is entitled to the right to purchase one share. This is to ensure that there is no excessive dilution to the underlying stocks.

Despite, the popularity of the warrants in Malaysia, there has been little study done on them, especially those that are empirical in nature. The lack of such studies may subject warrants to unjustified criticism from uninformed investors.

This paper is intended to determine the level of efficiency of the local warrants market. A market could be considered efficient if the market prices of the assets are consistent with that determined by a *fair price* model. The fair price model would take into consideration all relevant information that could impact the price of the asset. In efficient markets, such information would instantaneously be absorbed and be factored into the price of the asset. This would include the effect of transaction costs. The efficiency of warrants would be tested based mainly on an adjusted version of the **Black Scholes Options Pricing Model** since warrants exhibit many features of stock options. The adjustments are needed since several differences exist warrants and exchange traded options. These adjustments would be elaborated in Section III of this paper. The tests that have been designed are basically to ascertain the sensitivity of the local warrant market in absorbing information which are pertinent to ascertaining the prices of the warrants. If the market is generally efficient, there should be very little mis-pricing which is an indication that the market is pricing the warrants based on relevant information, rather than on rumours or unverifiable information.

Other characteristics of the warrants would also be explored such as their correlation to the market performance, age, and market capitalisation of the underlying stocks.

Since the local capital market is developing progressively, warrants have become an important security. The introduction of warrants could serve as a prelude for the launching of more exotic instruments on the KLSE (e.g., options and futures). The public should attain a high degree of maturity and understanding of the concepts relating to warrants before venturing into making investments in the new financial instruments. The lack of previous studies on local warrants is the prime motivator for this study. As such, it is difficult to gauge the maturity and efficiency of the local warrant market. Generally, since the BSOPM is a "close" model that uses a fixed number of parameters, the market should be able to incorporate the relevant information into the prices of the warrants. However, certain other issues, especially on the restriction of short selling (of both underlying stocks and warrants) may result in a certain level of mis-pricing, and as such, deviations from the fair-prices as determined by the BSOPM may be expected.

3. USING THE BSOPM MODEL FOR VALUING WARRANTS

As mentioned in section I of this paper, the BSOPM could be a viable model to value warrants. This model was developed by Black and Scholes in 1973 primarily to value options. The fair price of a call option is presented as :

$$C = S\,N(d_1) - K e^{-rt} N(d_2) \qquad \ldots \text{Eq 1}$$

where,

$N(d_1)$ and $N(d_2)$ are areas under the standard normal curve with variables d_1 and d_2.

$$d_1 = \frac{\ln(s/k) + [r + \frac{\sigma^2}{2}]\ t}{\sigma\ \sqrt{t}} \quad \ldots \text{Eq 2}$$

$$d_2 = d_1 - \sigma\ \sqrt{t} \quad \ldots \text{Eq 3}$$

S = current stock price K = exercise price

σ = volatility t = time to maturity (days/365)

r = risk free interest rate

Due to the differences between call options and warrants, the model has some flaws when used for valuation of warrants. Among the more prevalent problems are :

- The model assumes constant interest rates. This problem does not exist for call options since they have shorter life spans and interest rate could be expected to remain constant during such a duration
- The model does not take into account the dilution effect when warrants are exercised. Again, for call options this does not become an issue since exercising of call options does not bring about an increase in the number of the underlying stocks
- Dividends are also not accounted for by the model. For call options, this can also become a relevant issue if there happens to be some form of dividends during the life span of the options
- Warrants could be exercised early and therefore, in comparison with options, they can be viewed as American call options. The BSOPM was developed to price European call options whereby exercise could only be done upon maturity of the options

- Due to the short life span of options, volatility of the underlying stocks could be assumed as constant. However, in the case of warrants with longer maturities, the volatility of the underlying stock may vary during the life of the warrants.

As such, some adjustments need to be done if the model is to be used to value warrants. Firstly, to overcome the problem of the constant interest rate assumption, Merton (1973) has shown that the BSOPM could be altered for the purpose of valuing long maturing options by using the yield of a default free bond with matching maturities of the options. The yield of a long term government security with maturity similar to a warrant could be used as proxy to the risk-free rate in the BSOPM.

The issue of early exercise could be ignored since warrants are seldom exercised early. Exercising of warrants prior to maturity may only occur due to expectations of huge dividend. In the Malaysia context, whereby the average dividend payout ratio is only a meagre 1.75%, the problem of early exercise will hardly arise and therefore, most warrants will only have features like European Call Options whereby warrant holders will only choose to exercise upon maturity.

The effects of dividends to the price of options or warrants could easily be adjusted by factoring in the present value of the expected dividends into the underlying stock price in the BSOPM formula. The parameter S in the BSOPM formula (Eq 1) could then be replaced by S_0, whereby,

$$S_0 = S - \sum e^{-r_i} D_i \qquad \ldots \text{Eq } 4$$

where,

D_i = the dollar amount (per share of the i-th dividend)

Dubofsky (1992) is of the view that for the purpose of warrants valuation, the BSOPM formula just need to be modified to adjust for the dilution effect due to the increased number of shares. This is reflected simply by the following equation :

$$W = \frac{N}{(N/\gamma + M)} C \qquad \ldots \text{Eq 5}$$

where,

C = the value of a call option as computed with the original BSOPM model

N = the number of outstanding stock

M = the number of warrants

γ = the number of shares that can be purchased with each warrant (γ will be set as 1 henceforth, since nearly all of the present Malaysian warrants allow each warrant the right to purchase a single corresponding underlying share)

Galai and Schneller (1978) rationalised that the value of a warrant is equivalent to a company that is made up of pure equity (i.e., the company's equity structure prior to issuance of any warrants), adjusted by the dilution factor. The valuation of warrants should therefore be viewed from an equity perspective. Firstly, the total equity of the firm would increase when warrants are issued. The firms equity would therefore be made up of the total value of its stocks plus the value of the outstanding warrants. Therefore, the total equity value of a firm with warrants is :

Total Equity of firm $= S.N + W.M$

where,

S = Market price of each share W = Market price per warrant

N = Number of outstanding shares M = Number of outstanding warrants

The Equity per share value is thus given by :

$$\text{Equity value per share} = \text{Total Equity of firm / Total number of shares}$$

$$= (S.N + W.M)/N$$

$$= S + \frac{M}{N} W \qquad \ldots \text{Eq 6}$$

Therefore, for pricing of warrants using the BSOPM formula the following adjustments would have to be made :

- The stock price must be replaced by S + (M/N) W, with adjustment for dividends, to reflect the fact of each stock value to be based on equity per share
- The computation of volatility must be based on S + (M/N) W, instead of just purely the stock price
- The entire Call Option formula must be multiplied by N / (N + M), as postulated by Dubofsky, to account for the dilution effect.

The modified BSOPM for warrants valuation is therefore presented as :

$$W = \frac{N}{N+M}\left[(S-\sum e^{-rt_i}D_i+\frac{M}{N}W)N(d_1)-Ke^{-rt}N(d_2)\right] \quad \ldots \text{Eq 7}$$

where,

$$d_1 = \frac{\ln(\frac{S-\sum e^{-rt_i}D_i+(M/N)W}{K}) + rt}{\sigma\sqrt{t}} + \frac{\sigma\sqrt{t}}{2} \quad \ldots \text{Eq 8}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

S = current stock price

K = exercise price

t = time to maturity (days/365)

r = risk free interest rate

M = the number of warrants

W = price per warrant

N = number of outstanding shares of stock

t_i = time until i-th dividend is paid

Di = the amount of dividend per share of the i-th period

σ = standard deviation of the return of S + (M/N) W per unit time

N(d) = the cumulative normal distribution function for d

Lauterbach and Schultz (1990) found that the model above provided more accurate price forecasts as compared to the original version. The study covered all New York and American warrants from January 1971 to December 1980. Similarly, Kremer and Roenfeldt (1992)'s study for American warrants between the period of January 1981 to August 1985 also agreed that the prices predicted by the model is quite efficient.

Locally, Sy and Chan (97) used the model to price 12 Malaysian warrants for the period between Sep 92 and Aug 94. They too found that the model produced quite accurate pricing compared to actual market prices for 9 of the 12 warrants studied[4]. This study covers a wider selection of warrants (i.e., 34 warrants) and is done based on data that is more recent.

4. METHODOLOGY

A. Data Sampling

The study will encompass all warrants issued between 1 July 1994 and 31 December 1995. The period of analysis would include the period of 1 July 1994 and 31 December 1996 for the various statistical tests that are designed. Sometimes, eventhough a warrant is issued during the stipulated test period, it may only begin trading on a subsequent date. *The analysis would include such warrants too and as such the actual analysis period may include trading days after 31 December 1996.* Each of the test would cover the period of one calendar trading year, which is approximately 240 trading days.

[4] While the sample used in the study may not be of an optimal statistical size, the authors of the paper were forced to refer to such a small number of companies only. This is because, only a limited number of companies had issued warrants during the period of study. During the period under consideration, there were only 25 warrants which were traded on the KLSE. Out of the these, only 12 of these could be used since the rest registered very insignificant trading volumes.

The warrants used for analysis would have to fulfil the following criteria:

- The underlying stock should have only one outstanding warrant. It would be quite complicated to value warrants for companies that have issued more than one warrant at different times while an earlier issue has yet to expire
- The warrants used must possess a certain level of liquidity. For the purpose of this paper, a warrant would be considered as liquid if it has a daily average trading volume of more than 50,000 warrants (or 50 lots). Warrants whose average daily trading volume is below 50 lots would be dropped
- Warrants that are subjected to peculiar conditions such as changing exercise price or tenor would also be dropped

34 warrants were found to have fulfilled the above criteria. (refer to *APPENDIX 1 - Table I-1 : Summary Information of Warrants in the Study*). Two samples of data were used. The first sample covers the one year period after the warrants were first traded (henceforth known as the issuance date) and the second sample covers the period of 1 April 1996 to 31 March 1997[5]. This is to allow the analysis to be done based on the age of the warrants and also based on a cross-section of standard physical time frame. There were 8,600 and 8,500 observations under the first and second samples respectively.

[5] The second sample covers the period beyond 31 December 1996 since there were some warrants which had been issued at the end of 1995 but began trading only in the following year.

The other major parameters for estimation are :

i. **Stock Price** - The daily closing price of the underlying shares would be used. For purpose of the modified BSOPM model, the share price would be adjusted with the number of shares outstanding, number of warrants, and price of warrants. This is to adjust for the dilution effect.

ii. **Volatility**- The volatility of the underlying asset would be computed based on the relative log standard deviation method. The period of computation would be based on the duration of the analysis. Since volatility is the only subjective parameter in the BSOPM, it is important that the correct estimates be used. The period prior to issuance of the warrants should not be used for computation of volatility since a stock's volatility sometimes changes after having issued warrants due to the dilution effect and also variations in corporate capitalisation. Sy and Chan (1997) have postulated that in conducting empirical analysis based on historical data, the period under analysis should be used for computation of volatility. Again volatility is adjusted based on number of shares outstanding, number of warrants, and price of warrants. The computation of volatility would be based on the following :

$$r_{t2} = \ln\left(\frac{S'_{t2}}{S'_{t1}}\right) \qquad \text{where, } S' = S + (M/N)\,W$$

$$\bar{r} = \frac{1}{n} \sum r_t$$

$$\text{var}(r) = \frac{1}{n-1} \sum (r_t - \bar{r})^2$$

Since the above represents daily variance, the annual standard deviation is :

$$\sigma^2_{annual} = 365\sigma^2_{daily}$$

$$\sigma_{annual} = \sqrt{365\sigma^2_{daily}} = 19.1\,\sigma_{daily}$$

iii. **Number of shares and warrants outstanding** - The number of shares and warrants as per each closing financial year is used for computations in each of the corresponding periods.

iv. **Risk Free Interest Rates** - The gross redemption yield of Malaysian Government Securities with the closest matching maturity to the warrant under analysis would be used (since there may not be any MGS with identical maturity date with the warrants under study). The monthly yields of MGS are obtained from the Investor's Digest.

v. **Dividends** - The actual historical dividends would be used for adjustment of the BSOPM model. However, the following adjustments/assumptions are also made :

- Future dividends would be based on the latest reported dividend
- Dividends are assumed to be paid on a fixed date annually and that there is only 1 payment per year. For this purpose, the total dividends for the year would be used (if there are several interim payments in a year) and the dividend payment date would be taken as the date of the last reported dividend date (e.g., if in 1996 a company pays its dividends on 3 Mar 1997, it would be assumed that the company consistently pays dividend on 3rd

Mar every year). The annual dividends as reported in the Investor's Digest are used.

vi. **Transaction cost** - When factoring transaction costs in analysis, only the broker's commission would be considered. The other costs (such as clearing fee and stamping) would not be considered as they are quite small and are thus ignored. Therefore, transaction costs would be taken as a one round trip (buy and sell), i.e., 1% x 2 of the price of the warrants.

B. Statistical Tests

The following are the tests were designed to gauge the level of efficiency of the local warrants market :

i. Test of lower Boundary Violation

First, a plain "vanilla" test would be conducted to determine if the Malaysian warrants had violated a theoretical lower boundary price. *The main purpose of this test is to show the relevance of dilution for the purpose of pricing warrants.* A test on boundary violation would be done on the selected warrants without considering the dilution effect. The number of incidences of boundary violations could be expected to be significantly higher if compared to when the dilution effect is factored in.

The lower boundary for call options is propounded by Bhattacharya (1982) as follows (for non-dividend paying stocks) :

$$C \geq \max(0, S - Ke^{-rt}) \quad \ldots \text{Eq 9}$$

For the purpose of warrants, the above condition would be adjusted to accommodate changes in equity per share based due to issuance of warrants, and the continuous compounding of dividends which is presented as :

$$W \geq \max(0, S' - Ke^{-rt}) \quad \ldots \text{Eq 10}$$

where,

$$S' = S - \sum e^{-rt_i} D_i + \frac{M}{N} W \quad \ldots \text{Eq 11}$$

From an analytical viewpoint, the above equation reflects that a warrant's value (like an option) is made up of the intrinsic and time value. Even if a warrant's intrinsic value is zero (as in the case of out-of-the-money warrants), the warrant would still have a time value, i.e., the probability of a warrant becoming in-the-money during the tenure of its life, before expiration. Eq 9 and Eq 10 is therefore stipulating that an option or a warrant's value must at least factor in the time-value portion. The test which will be conducted will compare the actual price of the warrants against their respective lower boundary values which are computed as :

$$W_L = \max(0, S' - Ke^{-rt}) \quad \ldots \text{Eq 12}$$

A sample of the difference between the actual warrants price and the theoretical minimum value is obtained. The sample would be based on data obtained for the identified 34 warrants for the period of 1 year after the issuance of the warrants.