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# HEDGING WITH STOCK INDEX FUTURES IN HONG - KONG

PAR / BY

Ip YIU KEUNG, Charlmane WONG

Hong - Kong

# COUVERTURE PAR DES CONTRATS A TERME SUR INDICE BOURSIER A HONG - KONG

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IP YIU KEUNG, HONG KONO

RESUME

L'article traite de la fonction de couverture des contrats à terme sur indice boursier à Hong kong, compte tenu du rôle croissant de cette place dans les marchés financiers internationaux et des incertitudes politiques impliquées par l'échéance de 1987. la vente à découvert d'actions étant interdite à Hong Kong, le contrat à terme sur indice boursier est utilisé essentiellement comme instrument de couverture contre les baisses du marché boursier.

L'échantillon est constitué des cours de clôture quotidiens de l'indice Hang Seng et de trois différents types de contrats à terme sur indice - les types I, II et III, expirant respectivement à un, deux et trois mois civils ; observés du 6 mai 1986 au 31 décembre 1988. Les résultats indiquent que la couverture par des contrats à terme sur indice boursier procure effectivement une réduction du risque d'au mains 10 pour cent, et dans certains cas de plus de 90 pour cent. Les couvertures par le contrat à un mois pour des durées de detention plus longues, donnent les meilleurs résultats en termes de réduction du risque, de même que les contrats à terme à maturité courte tendent à suivre au plus près l'indice du comptant.

# HEDGING WITH STOCK INDEX FUTURES IN HONG KONG 125

BY YIU KEUNG IP *
AND
CHARLMANE WONG **

* DEPARTMENT OF FINANCE
THE CHINESE UNIVERSITY OF HONG KONG
HONG KONG

** CORPORATE FINANCE DIVISION
CITICORP INTERNATIONAL LTD.
HONG KONG

## INTRODUCTION

Futures on stock index was started trading in 1982 in the U.S. Since then, other countries such as the U.K., Japan, Singapore and Hong Kong have introduced the trading of stock index futures. Most markets have proven to be successful, with trading volumes growing rapidly. Investors welcome stock index futures because it greatly extends the range of investment and risk management strategies available to investors such as arbitrage and hedging.

One of the principal economic functions of a stock index futures market is to provide a facility for the management of risk in the stock market. The risk inherent in stock investment can be divided into two components : non - systematic risk and systematic risk Non -systematic risk refers to the risk caused by firm or industry specific factors, while systematic risk refers to the factors which impact the general condition of the stock market Non - systematic risk can be reduced by diversification. But systematic risks *cannot* be diversified away since all stocks tend to move with the market It could be however hedged through stock index futures. As Figlewski (1985) points out, stock index futures offers the possibility of directly managing the systematic risk of an equity position regardless of its position Through hedging, an investor can take opposite positions in the stock and futures markets to hedge away market risk

The Hong Kong Futures Exchange (HKFE) began trading stock index futures on the local Hang Seng Index (HSI) on May 6, 1986. Initially, the market was extremely successful with daily trading volume growing from about 1,800 contracts to more than 40,000 in mid - October 1987. It was then the largest trader of index futures per day outside the U.S. But the situation was completely reversed after the 1987 global stock market crash Trading volume has dropped dramatically to less than one thousand contracts per day.

Given Hong Kong's increasing role in international financial markets, this paper will examine the hedging function of the stock index futures in Hong Kong. The findings should be important and useful to Portfolio managers for risk management. There are two basic strategies which *can* be used in hedging with stock index futures : short hedges or selling hedges, and long hedges or buying hedges. A short hedge is used to protect the value of portfolio of stocks against potential market declines. It means taking a short position in stock index futures and the opposite long position in the stock market. A long hedge is used to lock in the current stock prices when a market rally is anticipated in the near future. It is done by holding a long position in stock index futures and shorting stock portfolios. Since short selling of stocks is prohibited in Hong Kong, long hedges cannot take place. The HSI futures is therefore used primarily to hedge against declines in the stock market.

## DATA AND METHODOLOGY

Daily closings of the Hang Seng Index, and three different types of index futures contracts Types I, II and III expiring in one, two and three calendar months respectively are used The entire sample period spans from May 6,1986, on which the HSI futures was introduced, to December 31,1988. Based on five different holding periods of one, two, three, ten and twenty days, the sample is subdivided into nonoverlapping periods of the given duration, leading to from about 30 observations f a 20 - day hedges to over six hundred observations for overnight hedges in the entire period. For ease in comparing results, mean returns and standard deviations are converted to annual rates by multiplying by 365 / N and $\sqrt{365/N}$ respectively, where N is the number of trading days in the holding period. Returns of the index portfolio and index futures are estimated as :

$$R_P = \frac{I_t - I_{t-1}}{I_{t-1}} + d_t$$

$$R_F = \frac{F_t - F_{t-1}}{F_{t-1}}$$

where $R_P$ = retum of the index portfolio
$R_F$ = retum of the index futures
d = dividend yield of the index portfolio
I = closing of the market index
F = closing of the index futures

Following Figlewski (1985), retum and variance for a hedged position are given by :

$$R_H = R_P - hR_F$$

$$var[R_H] = var[R_P] + h^2 var[R_F] - 2h cov[r_P, R_F]$$

where $R_H$ = return of the hedged portfolio,
var { } = variance
cov ( } = covariance
h = hedge ratio

The hedge ratio to be used here is the risk-minimizing hedge ratio. Figlewski (1985) finds that the risk - minimizing hedge ratio produces better hedging results than commonly used beta coefficient. To find the risk - minimizing hedge ratio, the derivative of var $\{R_H\}$ with respect to h is set equal to zero to obtain :

$$h^* = cov[R_P, R_F] / var[R_F]$$

Throughout this paper, the retum and variance of the hedged portfolio are thus estimated as :

$$R_H = R_P - h^* R_F$$

$$var[R_H] = var[R_P] + h^{*2} var[R_F] - 2h^* cov[R_P, R_F]$$

The correlation between the spot and futures prices is first examined as the correlation between $R_P$ and $R_F$ plays an important role in determining the results of hedging. Trends in return and risk of the index and futures portfolios are then to be identified. Finally, the hedging ability of the HSI futures is evaluated based on two criteria, namely, its ability to reduce risk, and the overall performance of the hedged portfolio. The first criterion is measured by a ratio of hedged portfolio's standard deviation to that of the unhedged portfolio. The second is measured by the Sharpe's reward to volatility ratio.

## EMPIRICAL RESULTS

### Correlation

Table 1 reports the correlation coefficients which show the relationship among the return of the index portfolio and the returns of different types of futures contracts. From Table 1, it can be seen that the correlation between the return of the index portfolio $R_p$ and the return of Type I index futures $R_F$ (I) is as high as 0.9. Futures contracts with a shorter maturity tend to follow the spot index more closely than those with a longer maturity. The correlation coefficient between $R_p$ and $R_F$ (11) falls drastically to 0.53 and that between $R_p$ and $R_F$ {III} falls slightly further to 0.50.

Table 1 : Correlation Coefficients for Daily Returns of Spot Index and the Three Index Futures Contracts

| | $R_P$ | $R_F$ [I] | $R_F$ [II] | $R_F$ [III] |
|---|---|---|---|---|
| $R_P$ | 1 | 0.90 | 0.53 | 0.50 |
| $R_F$ [I] | | 1 | 0.55 | 0.49 |
| $R_F$ [II] | | | 1 | 0.93 |
| $R_F$ [III] | | | | 1 |

Table 2 further examines the correlation between the return on the spot index and the return on the three different types of futures for the pre - crash and the post - crash periods separately. Correlation coefficients are closer to each other in the pre-crash period. But the correlation f a Type I futures is relatively much higher than those for Types II and III futures after the crash. One possible explanation fa the phenomenon that appears in the post-crash period is that trading volumes in Types II and III futures contracts were relatively much smaller during this period.

Table 2 : Correlation Coefficients for Daily Returns before and after Crash

| | | Rt [I] | Rt [II] | $R_F$ [III] |
|---|---|---|---|---|
| Rr | Pre-crash | 0.91 | 0.89 | 0.90 |
| | Post-crash | 0.76 | 0.44 | 0.42 |

Table 2 further shows that the relationship between $R_P$ and $R_F$ is substantially weaker in the post - crash period in general. There are two possible reasons, First, returns in the post - crash period were more volatile, as will be shown later. It is more difficult f a the index futures to follow the spot index closely. Second, more importantly the volume of all futures trading dropped dramatically after the crash

Table 3 : Correlation Coefficients for Different Holding Periods

| | | $R_F$ [I] | $R_F$ [II] | $R_F$ [III] |
|---|---|---|---|---|
| $R_P$ | 1 day | 0.90 | 0.53 | 0.50 |
| | 2 days | 0.96 | 0.57 | 0.53 |
| | 3 days | 0.95 | 0.88 | 0.60 |
| | 10 days | 0.99 | 0.97 | 0.98 |
| | 20 days | 0.99 | 0.99 | 0.99 |

The length of the holding period also causes differences in correlations. In Table 3, correlation coefficients are shown for different durations throughout the entire sample period. There is a significant increase in correlation as the length of the holding period increases. This trend is more obvious for Types II and III contracts. The correlation coefficients between both $R_P$ and $R_F$ (II), and $R_P$ and $R_F$ (III) rise more drastically than that between $R_P$ and $R_F$ (I).

Reduction in Risk

Table 4 reports the average returns (R) and standard deviations ($\sigma$) of the index Portfolio and three types of futures contracts. All returns are highest in the pre - crash period and lowest in the post - crash period. Risks for the index portfolio and Type I futures are lower in the post - crash period than over the entire sample period, but those for Types II and III contracts show an opposite pattern. The larger standard deviation in the post-crash period for Types II and III contracts reflects the fact that risk is indeed higher far these contracts during this period.

Table 4 : Returns and Standard Deviations of Index and Futures Portfolios

| Contract | | | | I | | II | | III | |
|---|---|---|---|---|---|---|---|---|---|
| Holding Period | Sample Period | $R_P$ | $\sigma_P$ | $R_F$ | $\sigma_F$ | $R_F$ | $\sigma_F$ | $R_F$ | $\sigma_F$ |
| 1 day | Entire | 0.25 | 0.38 | 0.20 | 0.48 | 0.23 | 0.37 | 0.23 | 0.40 |
| | Pre-Crash | 0.63 | 0.25 | 0.48 | 0.24 | 0.64 | 0.23 | 0.75 | 0.24 |
| | Port-Crash | 0.26 | 0.30 | 0.44 | 0.41 | -0.17 | 0.48 | -0.17 | 0.50 |
| 2 days | Entire | 0.25 | 0.43 | 0.18 | 0.52 | 0.26 | 0.43 | 0.23 | 0.45 |
| | Pre-Crash | 0.75 | 0.24 | 0.60 | 0.25. | 0.73 | 0.23 | 0.81 | 0.24 |
| | Port-Crash | 0.23 | 0.33 | 0.35 | 0.43 | -0.13 | 0.55 | -0.15 | 0.55 |
| 3 days | Entire | 0.36 | 0.40 | 0.21 | 0.44 | 0.22, | 0.40 | 0.36 | 0.46 |
| | Pre-Crash | 0.79 | 0.23 | 0.63 | 0.24 | 0.68 | 0.23 | 0.98 | 0.28 |
| | Post-Crash | 0.36 | 0.30 | 0.26 | 0.34 | 0.04 | 0.42 | -0.07 | 0.56 |
| 10 days | Entire | 0.32 | 0.48 | 0.20 | 0.52 | 0.35 | 0.49 | 0.36 | 0.50 |
| 20 days | Entire | 0.30 | 0.44 | 0.18 | 0.44 | 0.32 | 0.44 | 0.35 | 0.47 |

Types II and III futures contracts have higher return than that of Type I in the pre-crash period but much lower return in period after the crash. It seems that Types II and III contracts are more profitable than Type I contracts in the pre-crash period because they have much higher returns than Type I but more or less the same risk. But the opposite is true in the post - crash period in which they have negative return and much higher risk.

Table 4 also indicates that in general, both return and risk increase as the length of holding period increases. This is logical since prices usually do not change in a large extent in a day. In addition, Types II and III futures contracts seem to have a strong trend of higher return and standard deviation as the length of holding period increases.

The standard deviation of returns on the hedged portfolio as a fraction of the unhedged portfolio is reported in Table 5 as an indicator for the hedging ability of the HSI index futures. Returns on the unhedged and hedged Portfolios, are also shown to illustrate the effect of hedging on portfolio returns. The results in Table 5 indicate that hedging does lead to a reduction in risk of at least ten percent and can reduce risk by slightly over 90 percent in some cases. In all cases, hedges with longer holding periods perform better in terms of risk reduction. With a holding period of 20 days, the standard deviation of the hedged portfolio is only 10 percent of that of an unhedged portfolio on average, while the ratio ranges from 43 percent to 88 percent for different types of contracts when the hedge is overnight.

Among the various types of contracts, Type I contract shows the greatest ability to reduce risk through hedging. The relative differences are more pronounced in hedges of shorter duration

Table 5 : Hedge Performance of HSI Futures

| Contract | | | I | | II | | III | |
|---|---|---|---|---|---|---|---|---|
| Holding Period | Sample Period | $R_P$ | $R_H$ | $\sigma_H/\sigma_P$ | $R_H$ | $\sigma_H/\sigma_P$ | $R_H$ | $\sigma_H/\sigma_P$ |
| 1 day | Entire | 0.25 | 0.08 | 0.43 | 0.14 | 0.83 | 0.16 | 0.88 |
| | Pre-Crash | 0.63 | 0.13 | 0.42 | 0.02 | 0.45 | -0.02 | 0.45 |
| | Post-Crash | 0.26 | -0.01 | 0.67 | 0.30 | 0.89 | 0.30 | 0.90 |
| 2 days | Entire | 0.25 | 0.07 | 0.30 | 0.14 | 0.79 | 0.14 | 0.86 |
| | Pre-Crash | 0.75 | 0.17 | 0.38 | 0.07 | 0.40 | 0.07 | 0.42 |
| | Post-Crash | 0.23 | -0.07 | 0.46 | 0.29 | 0.88 | 0.29 | 0.91 |
| 3 days | Entire | 0.36 | 0.06 | 0.29 | 0.06 | 9.44 | 0.39 | 0.88 |
| | Pre-Crash | 0.79 | 0.15 | 0.44 | 0.10 | 0.21 | 0.31 | 0.62 |
| | Post-Crash | 0.36 | -0.03 | 0.43 | 0.13 | 0.55 | 0.78 | 9.90 |
| 10 days | Entire | 0.32 | 0.02 | 0.14 | 0.04 | 0.23 | 0.04 | 0.14 |
| 20 days | Entire | 0.30 | 0.02 | 0.08 | 0.04 | 0.11 | 0.04 | 0.12 |

For hedging performance in different periods, reduction of risk is greatest in the pre-crash period and lowest in the post - crash period in most cases. This result is even more obvious f a Types II and III contracts.

Risk reduction seems to have a definite relationship with the correlation between returns of the index portfolio and the returns of the futures. The higher the correlation, the greater the risk reduction ability. In Tables 1 to 3, correlation gets si cantly higher as duration increases, and this increase in correlation is more si cant for Types II and III contracts. In addition, correlation is highest between return of index portfolio and return of Type I futures contract, and lowest between return of index portfolio and return of Type III index futures contract Correlation is also higher in the pre - crash period. Implications to investors is that it is better for them to exploit the ability of index futures to hedge against portfolio risk in times when the spot and futures prices move closely together. In times when the market fluctuates so much that they do not correlate closely, it would be more difficult to hedge the systematic risk of the stock market through the futures market.

One should always bear in mind the effects an return when hedging is used to reduce risk Table 5 indicates that there is always a sacrifice in return when risk is reduced by hedging. A greater reduction in risk is always accompanied by a larger cut in return. Using Type I contract as an example, an overnight hedge could reduce risk by 57 percent and lower return from 25 percent to 8 percent during the entire sample period. The return of the hedged portfolio is only 2 percent as compared to an unhedged return of 30 percent for a holding period of 20 days. In this case, the return is even less than the riskless rate of return, which is estimated to be five percent on average during this period. In the post - crash period, returns of the hedged portfolio when Type I futures contract is used even become negative.

## Overall Performance

If the sole objective of hedging is to reduce risk, then the ratio $\sigma_H$ / up is good enough to be used to evaluate the hedging performance. But if the portfolio return also needs to be taken into consideration, then another measure for evaluation is required. In this section, the Sharpe's reward to volatility index is used to evaluate portfolios' overall performance. The Sharpe's index is defined as the portfolio's return above the risk-free rate divided by the standard deviation of the portfolio's return. This ratio is also often referred to as a measure of excess return to variability.

Table 6 shows the Sharpe's measure f a the index portfolio, various futures portfolios, and hedged portfolios. The risk - free rate is estimated to be an average of five percent in all periods. First, the Sharpe's measure is highest in the period before the crash, in which returns are high and risks are low. There does not seem to be any obvious trend in the Sharpe's measure as duration lengthens. This can be explained by the fact that the increase in return as duration gets longer is accompanied by an increase in standard deviation. For the futures portfolios, Type I futures demonstrates the lowest Sharpe's index while Type III futures has the highest in the pre-crash period as well as in the entire sample period.

The situation however is reversed in the post-crash period. Types II and III futures perform worse after the crash. The two types of futures portfolios incur losses *during* this period. So those who speculate in the futures market by longing Types II and III contracts suffer a loss on average in the post - crash period. But those who use them in hedging benefit more than those who use Type I futures in terms of excess return relative to risk. The Sharpe's measure for hedged portfolios is higher on average for Type 11 and III contracts than that for Type L Although Type I contract is more useful to reduce risk, it also has mare dampening effects on return.

Table 6 : Sharpe's Reward to Volatility Measure for Portfolio's Performance

| Contract | | | I | | II | | III | |
|---|---|---|---|---|---|---|---|---|
| Holding Period | Sample Period | $\frac{R_P - r}{\sigma_P}$ | $\frac{R_F - r}{\sigma_F}$ | $\frac{R_H - r}{\sigma_H}$ | $\frac{R_F - r}{\sigma_F}$ | $\frac{R_H - r}{\sigma_H}$ | $\frac{R_F - r}{\sigma_F}$ | $\frac{R_H - r}{\sigma_H}$ |
| 1 day | Entire | 0.54 | 0.31 | 0.18 | 0.49 | 0.30 | 0.47 | 0.32 |
| | Pre-Crash | 2.31 | 1.76 | 0.72 | 2.54 | -0.29 | 2.90 | -0.58 |
| | Post-Crash | 0.68 | 0.96 | -0.27 | -0.45 | 0.94 | -0.45 | 0.93 |
| 2 days | Entire | 0.48 | 0.26 | 0.12 | 0.49 | 0.27 | 0.40 | 0.25 |
| | Pre-Crash | 2.93 | 2.24 | 1.28 | 2.89 | 0.25 | 3.11 | 0.15 |
| | Post-Crash | 0.54 | 0.71 | -0.78 | -0.32 | 0.81 | -0.37 | 0.80 |
| 3 days | Entire | 0.76 | 0.36 | 0.07 | 0.41 | 0.08 | 0.66 | 0.96 |
| | Pre-Crash | 3.17 | 2.45 | 0.91 | 2.67 | 0.53 | 3.29 | 1.85 |
| | Post-Crash | 1.03 | 0.62 | -0.58 | -0.03 | 0.46 | -0.20 | 2.71 |
| 10 days | Entire | 0.56 | 0.28 | -0.42 | 0.61 | -0.05 | 0.61 | -0.20 |
| 20 days | Entire | 0.58 | 0.30 | -0.89 | 0.62 | -0.24 | 0.64 | -0.19 |

Overall speaking, the Sharpe's measures for hedged portfolios are lower than that of the index portfolio. In other words, excess return relative to variability is greater for the unhedged index portfolio than hedged portfolios. In many cases in the post-crash period, and also when the length of the holding period extends to 10 days, the Sharpe's measure for hedged portfolios even become negative, which means that the hedged return is below the risk - free rate.

## CONCLUDING REMARKS

After the Crash, it is more difficult to hedge away the systematic risk in the stock market of Hong Kong through the HSI futures as the correlation between spot and futures prices of the HSI has fallen. Nevertheless, the findings show that hedging through the index futures could result in substantial risk **reduction.** From the ex post point of view, hedging with the index futures was costly in terms of lower return. However, in view of higher volatility of stock prices due to increasing political uncertainty in **Hong** Kong, the index futures should still be an valuable instrument **to** be considered f a risk management.

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