Trading Volume as Determinant of Dynamic Extreme Value at Risk in Futures Markets

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Abstract

The dynamic EVT-based GARCH model has evolved as a preferred approach in the estimation of value at risk ,VaR,, in global financial institutions. Sophisticated risk models also require full information, however, the traditional standard dynamic VaR model failed to account for an important nature of return volatility driven by asymmetric volume changes in the financial markets. The main objective of this study is to investigate whether an incorporation of trading volume improve the accuracy in the estimation of VaR in future markets.

Using alternative dynamic EVT-based GARCH family VaR models including GARCH+GPD+V, GJR+GPD+V and EGARCH+GPD+V, over the period from Jan. 1997 to Dec 2001, the study examine VaRs of three major US futures markets, NASDAQ INDEX, S&P 500 INDEX and NATURAL GAS. Consistent with our *a-priori* expectation, the finding indicates that the proposed alternative dynamic EVT-based GARCH family VaR models with volumes, in general, outperform traditional dynamic EVT-based VaR models. In particular, GJR+GPD+V is the best model among the others in terms of both rate of violation and RMSE.

Key words: Extreme Value Theory, Trading volume, Futures markets, GARCH

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1. Introduction

In recent years, a string of financial failures resulted from inappropriate overwhelming speculation on derivatives and lack of sufficient internal controls have raised considerable concern of market risks among regulators, financial institutions, financial analyst and other participants in the financial markets. For example, in December 1994, Orange County in U.S. had suffered a ever recoded loss of US$1.6

삭제됨: Option-based Dynamic Hedging of Convertible Bond with Credit Risk
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millions attributed to the unsupervised investment of its treasurer in derivatives securities. In February 1995, a U. K. merchant bank, Barings, was forced into insolvency as a result of huge losses of US$1.3 billions on its trading in Nikkie stock index future in Japan. In September 1995, a similar incident took place at New York branch of Daiwa Bank resulted from futures trading. In 1997, Eastern Europe and Asia also encountered considerable currency and financial market volatility. This volatility was further magnified throughout 1998 with large losses on Russian bonds as the Russia's ruble depreciated and the price of Russian bonds collapsed. That volatility had forced many large U.S. banks to write off hundred millions of dollars losses on holding Russian government securities.

In response to the above financial disasters, Bank of International Settlement (BIS) revised Basel Accord I in 1998 and required all financial institutions report market risks of their portfolios and impose capital charges accordingly to restrict the finical institutions from over risk-taking. Subsequently, BIS encourages financial institutions to develop more sophisticated tailor-made model of measuring risks in Basel accord II 2006. The market risk is commonly refereed as value change resulting from a change in price, interest rate, market volatility and market liquidity. It can be formally defined as value at risk (VaR) which measures the expected maximum loss (or worst loss) over a target horizon within a given confidence interval. The methods to estimate the VaR can be categorized into parametric and non-parametric. Initially, the most popular model was Riskmetric developed by J. P. Morgan Stanley 1994 because of easy use. This traditional variance-covariance-based VaR model, however, fails to account for two important natures of return series: stochastic volatility and fat-tail distribution. More specifically, the traditional method is focused on the confidence interval rather than tail probability of financial return series. Financial literature has well documented that return series in the financial markets are stochastic and fat-tail distributed in nature (Bollerslev ,1986, 1992; Diebold, 2000). In fact, risk managers are more concerned with the tail behaviors of market returns. Mathematically, Extreme Value theory (EVT) approach holds promise for more accurate capturing the extreme quintiles and tail probabilities of financial return series. Nevertheless, traditional EVT techniques assume that finical asset return is iid and hence fails to account for the other behavior of the asset return series, dynamic clustering of asymmetric stochastic volatility (Diebold et al., 2000; McNeil et al. , 2000). On the other hand, ARCH/GARCH family models are well recognized as a successful method in capturing the stochastic volatility (Bollerslev ,1986, 1992; Nelson, 1991; Koutmos et al. 1995). After the pioneer work of McNeil (1997, 1998, 2000) in the finical risk management, the EVT-based dynamic GARCH model has evolved as a preferred approach in the estimation of VaR (McNeil, 2000, Longin, 2000; Bystrom,

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2004; Gencay et al., 2004;Fernandez, 2005). Yet, previous works ignore the possible correlation between the financial asset return and trading volume. Numerous financial studies have well documented this important relationship. Clark (1973) and Epps and Epps (1976) suggested that trading volume is a good proxy for information arrival from the capital market. The hypothesis has been further supported by empirical evidence; Lamoureux and Lastrapes (1990), Kim and Kon (1994), Andersen (1996), Gallo and Pacini (2000) found the same effect for the US stock market; Omran and McKenzie (2000) observed this effect for the UK stock market; Bohl and Henke (2003) reported similar evidence for the Polish stock market.

Ying (1966) was the first to provide strong empirical evidence supporting an asymmetric relation between trading volume and price-change. By investigating six series of daily data from NYSE, Ying made the following conclusions: a small trading volume is usually accompanied by a fall in price; a large volume is usually accompanied by a rise in price; and a large increase in volume is usually accompanied by either a large rise in price or a large fall in price. This hypothesis is also documented by Karpoff (1987) in an extensive survey of research into the relationship between stock–price change and trading volume. Karpoff suggests several reasons why the volume–price change relationship is important and provides evidence to support the asymmetric volume–price change hypothesis. His asymmetric hypothesis implies that the correlation between volume and price change is positive when the market trend is going up, but that this correlation is negative when the market trend is downwards. This is again important and highlights that we should not simply add a linear exogenous volume term to the mean equation in a GARCH model for stock returns. To capture the possible nonlinearity we will also consider an asymmetric linear relationship between price (return) and volume, as can be captured by GJR GARCH and EGARCH models.

Departing from traditional work that focused on the contemporaneous relation between return and trading volume, Chordia and Swaminathan (2000) examine the causal relationship and the predictive power of trading volume on the short-term stock return. Their empirical evidence suggests that volume plays a substantial role in the dissemination of national market-wide information. In a dynamic context, Lee and Rui (2002) utilize the GARCH(1,1) model to investigate the relationship between stock returns and trading volume using the New York, Tokyo and London stock markets. Their empirical results suggest that US .financial market variables, in particular US trading volume, have extensive predictive power in both the domestic and cross-country markets, after the 1987 market crash.

Similarly, the asymmetric price change and trading volume relationships also documented by an extensive study in the derivative literature (Cooper, 1999; Fung

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and Patterson 1999; Lee and Swaminanthan, 2000; Besseminder and Seguin, 1992; Locke and Sayers, 1993; Moosa, Silvapulle and Silvapulle, 2003). In particular, Fun et. al. (1999) utilize Vector autoregressive analysis to examine the relationship of volatility, volume and market depth, and the direction and speed of the information flow between variables in five currency futures markets. The finding suggests that the return volatility is subject to strong reversal effects form trading volume and market depth. In addition, Moosa et al. (2003) employ a bivariate VAR model and find significant mean level asymmetry in the price–volume relationship for the future market in crude oil prices; they did not consider a heteroscedastic model and they enforced the threshold variable to be zero. The above findings further enforce our belief that a consideration of trading volume as an explanatory variable might not only add to the understanding of derivatives market behavior in general but improve the accuracy in the estimation of market risk in particular.

The objective of this study is to investigate whether an incorporation of trading volume improve the accuracy in the estimation of VaR in future markets. Consistent with our a-priori expectation, our results indicates EVT-based GARCH family VaR models with volumes, in general, outperform the standard dynamic VaR model and shed the light on the use of trading volume as determinant of dynamic VaR in Futures market.

The remainder of this study proceeds as follows. Section 2 describes the experiment design including the methods and model specifications used in this paper. Section 3 presents an evaluation of alternative models via backtestings. The paper concludes with a summary analysis of the findings in section 4.

2. Methodology

In the risk management literature, McNeil et al. (2000) provide an extensive study on the EVT-based models which have been developed to model the tail distribution of financial asset returns. They conclude that traditional EVT-based works by Longin (1997, 2000) and McNeil et al. (1997, 1998) failed to account for the stochastic volatility effect and suggest that a combination of EVT-based model with GARCH family in a dynamic framework will be provide more accurate estimation on the VaR of financial assets. More specifically, McNeil et al. (2000) filter return series via GARCH model and then utilize a threshold-based EVT technique to estimate VaR in the extreme return series. Recently, Bystrom (2004) expend McNeil's study by adding one extra dimension, the Block Maxima method, to model the tail return distribution and generate similar result. Following Bystrom (2004), we adopt two-stage estimation procedure to estimate the dynamic VaR. In the first stage, we filters different financial

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time series with a GARCH model. More specifically, the study fits a GARCH-type model to the return data by maximum likelihood. That is, maximize the log-likelihood function of the sample assuming normal innovations; finally, we consider the standardized residuals computed in stage 1 to be realizations of a white noise process, and estimate the tails of innovations using EVT. In particular, we extend the previous work by adding the GJR and EGARCH models to account for asymmetric conditional volatility effect. Furthermore, we formulate the above models adding trading volume as an explanatory variable in the estimation of Var. The empirical process of this study is presented in the following subsections.

2. 1. GARCH-type models

In the investment literature, there are several different approaches have been utilized to model financial asset returns. Following the pioneer work of Bollerslev (1986, 1992), the GARCH class model has become a superior model in assessing the stochastic volatility of financial instruments. The most successful and popular among the others is the GARCH family model with AR-GARCH(1,1) specification (Engle, 1982; Bollerslev, 1986; Gerlach et al., 2006). This popularity is also the motivation behind our choice of GARCH as representing a parametric model for filtering stock returns. As opposed to the EVT-based models described above, GARCH models do not focus directly on the returns in the tails. Instead, GARCH models explicitly model the conditional volatility as a function of past conditional volatilities and returns.

For simplicity, we adopt standard GARCH(1,1) model to capture the stochastic return volatility of the underlying assets. The AR-GARCH(1,1) model can be defined as follow:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \varepsilon_t$$

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \quad (1)$$

where, residual $\varepsilon_t | \Omega_{t-1} \sim N(0, \sigma_t^2)$ with mean=0, Variance= σ_t^2, h_t is the conditional variance at time t, and Ω_t is the information set of all information through time *t*. Whereas, α_0, α_1, α and β are parameters to be estimated. When the AR-GARCH model in Eq. (1) has been fitted to data by maximization of the likelihood function, one can estimate (or forecast) dynamic VaR_p measures by assuming either the normal

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삭제됨: **2.1 Modelling the tails of stock return distributions**

Traditional methods to estimate the tail distribution under EVT theory can be divided into two groups: the peaks over threshold (POT) method which looks at those events in the data that exceed a high threshold, and block maxima method (BMM) which divides the data into consecutive blocks and focuses on the series of maxima (or minima) in these blocks (Embrechts et al., 1997; Kellezi & Gilli, 2000; McNeil, 1998; Bystrom (2004)). Bystrom (2004) suggest that both BMM and POT generate similar results in estimating and forecasting both conditional and unconditional VaR. Nerveless, BMM requires long histories for estimation. Therefore, this study adopts POT method to estimate the underlying VaRs. Under POT method, we collect ... [15]

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distribution or the t distribution, multiplying one's estimates (or forecasts) of σ_t with the standard quantiles of each distribution, and finally adding the conditional mean. As cited by previous literature, in comparing to the unconditional EVT-based methods described earlier, the AR-GARCH models have the advantage of producing time varying VaR_p measures (Engle, 1982; Bollerslev, 1986; Diebold et al. 1999; Gerlach et al., 2006). Yet, the recent literature further suggest that return series of current financial markets tends to have volatility clustering behaviors and the asymmetric type GARCH model will provide better estimation of conditional volatility (Nelson, 1991; Gerlach et al., 2006). The nature of clustering volatility in the financial asset has been ignored in the previous EVT-based VaR models. This study fills in the gap by adding two asymmetric type GARCH models, GJR and EGARCH.

The model specifications of asymmetric GARCH models are addressed in the following subsections. In GJR framework, the effects of positive shocks (or upward movements in the patent share) on the conditional variance, h_t, are assumed to be the same as the negative shocks (or downward movements in the patent share) in the symmetric GARCH model. In order to accommodate asymmetric behaviour, Glosten et al. (1992) proposed the GJR model, for which GJR(1,1) is defined as follows:

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$$h_t = \omega + (\alpha + \gamma I(\eta_{t-1}))\varepsilon_{t-1}^2 + \beta h_{t-1}, \qquad (2)$$

where $\omega>0$, $\alpha \geq 0$, $\alpha + \gamma \geq 0$, $\beta \geq 0$ are sufficient conditions for $h_t>0$, and $I(\eta_t)$ is an indicator variable defined by

$$I(\eta_t) = \begin{cases} 1, & \varepsilon_t < 0, \\ 0, & \varepsilon_t \geq 0. \end{cases}$$

as η_t has the same sign as ε_t. The indicator variable differentiates between positive and negative shocks, so that asymmetric effects in the data are captured by the coefficient γ, with $\gamma \geq 0$. The asymmetric effect, γ, measures the contribution of shocks to both short run persistence, $\alpha+\gamma/2$, and to long run persistence, $\alpha+\beta+\gamma/2$.

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As for the alternative asymmetric volatility in the conditional variance, the Exponential GARCH (EGARCH(1,1)) model of Nelson (1991), can be formulated as

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$$\log h_t = \omega + \alpha|\eta_{t-1}| + \gamma\eta_{t-1} + \beta \log h_{t-1}, \quad |\beta| < 1. \qquad (3)$$

According to Nelson (1991) and Shephard (1996), there are five distinct differences between EGARCH and the previous two GARCH models: (1) EGARCH is a model of the logarithm of the conditional variance, which implies that no restrictions on the parameters are required to ensure h_t>0, (2) $|\beta|$<1 ensures stationarity and ergodicity for EGARCH(1,1), (3) $|\beta|$<1 is likely to be a sufficient condition for consistency of Quasi Maximum Likelihood Estimation (QMLE) for EGARCH(1,1), (4) $|\beta|$<1 would seem to be a sufficient condition for the existence of moments as the conditional (or standardized) shocks appear, (5) in addition to being a sufficient condition for consistency, $|\beta|$<1 is also likely to be sufficient for asymptotic normality of the QMLE of EGARCH(1,1). Furthermore, EGARCH captures asymmetries differently from GJR. The parameters α and γ in EGARCH(1,1) represent the magnitude (or size) and sign effects of the conditional (or standardized) shocks, respectively, on the conditional variance, whereas α and $\alpha+\gamma$ represent the effects of positive and negative shocks, respectively, on the conditional variance in GJR(1,1). Furthermore, as our a-priori expectation from theoretically ground stated in the introduction of this study, an incorporation of trading volume into the traditional EVT-based VaR models might improve the accuracy in estimating VaRs. Therefore, we add volume as an explanatory variable, denoted as V, into each of the previous GARCH-family equations to examine such effect. For example, the conditional variance equation of alternative GARCH model, GJR model and EGARCH model can be formulated in the equation (4) through (6), respectively.

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$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + V_t. \qquad (4)$$

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$$h_t = \omega + (\alpha + \gamma I(\eta_{t-1}))\varepsilon_{t-1}^2 + \beta h_{t-1} + V_t \qquad (5)$$

삭제됨: 12

$$\log h_t = \omega + \alpha|\eta_{t-1}| + \gamma\eta_{t-1} + \beta\log h_{t-1} + V_t, \quad |\beta| < 1 \qquad (6)$$

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Follow Bystrom (2004), we scale our unconditional EVT-based tail estimates with the expected return and volatility. Than, we obtain the forecasts of tail risks that are conditional on the actual market conditions. Thus, after the standardize residual, η_t, from the AR-GARCH model in the first stage in Eq. (1) and the residual distribution quantiles, α_p, ar obtained, we can calculate the forecasted VaR_p quantiles of our return distribution tomorrow as

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$$\mathrm{VaR}_{t+1,p} = \alpha_0 + \alpha_1 r_t + \sigma_{t+1}\alpha_p \qquad (7)$$

where $a_0+a_1r_t$ is the conditional mean and σ_{t+1} is the GARCH forecast of tomorrow's conditional volatility. Note that the major advantage with first filtering the returns is to obtain IID series which can straightforward to apply the EVT technique. Yet, it is common in the finance literature to apply the EVT technique to financial return series that are known to be non-IID (McNeil et al., 2000; Bystrom, 2004).

2.2. Modeling the tails of sample return distributions

Traditional methods to estimate the tail distribution under EVT theory can be divided into two groups: the peaks over threshold (POT) method which looks at those events in the data that exceed a high threshold, and block maxima method (BMM) which divides the data into consecutive blocks and focuses on the series of maxima (or minima) in these blocks (Embrechts et al., 1997; Kellezi & Gilli, 2000; McNeil, 1998; Bystrom (2004)). Bystrom (2004) suggest that both BMM and POT generate similar results in estimating and forecasting both conditional and unconditional VaR. Nerveless, BMM requires long histories for estimation. Therefore, this study adopts POT method to estimate the underlying VaRs.

Under POT method, we collect those returns in the sample series that exceed a certain high threshold, u, and model these returns separately from the rest of the distribution. Note that the choice of threshold value, u, is the most important implementation issue in the estimation of EVT. McNeil et al.(2000) set 10% as the value of threshold, u, after a careful simulation. Following the study, we set 10% as our threshold value in our empirical implementation at backtesting stage.

As Bystrom (2004), we define a daily return in our data series as R and assume that it comes from a distribution F_R. The returns above the threshold u then follow the excess distribution $F_u(y)$ that is given by

$$F_u(y) = P(\text{R-}u \le \text{y} \mid \text{R} > u) = \frac{F_R(u+y) - F_R(u)}{1 - F_R(u)}, \quad 0 \le y \le R_F - u \qquad (8)$$

where y is the excess over u, and R_F is the right endpoint of F_R. If the threshold, u, is high enough, Balkema et al. (1974) and Pickands (1975) show that for a large class of distributions, F_R, the excess distribution, $F_u(y)$, can be approximated by the so-called generalized Pareto distribution (GPD), which can be formulated as

$$\lim_{u\uparrow} \sup_{0 \le y \le R_F - u} \left| F_u(y) - G_{\xi,\beta}(y) \right| = 0 \qquad (9)$$

$$G_{\xi,\alpha}(y) = \left[1-(1+\frac{\xi}{\alpha}y)\right]^{\frac{-1}{\xi}} \quad \text{,if } \xi \neq 0$$

$$G_{\xi,\alpha}(y) = 1-e^{\frac{-y}{\alpha}} \quad \text{,if } \xi = 0 \qquad (10)$$

for $0 \le y \le R_F - u$. ξ is the tail index and for the fat-tailed distributions found in finance, one can expect a positive ξ. α is just a positive scaling parameter. Empirically, the tail index, ξ, as well as the scaling parameter, α, have to be determined by fitting the GPD to the actual data. These parameters are typically estimated via the maximum likelihood method:

$$\max L_G(\xi,\alpha;\mathbf{y}) = \max \sum_i \ln\left(g_{\xi,\alpha}(y_i)\right), \qquad (11)$$

where $g_{\xi,\alpha}(y) = \frac{1}{\alpha}(1+\frac{\xi}{\alpha}y)^{-\left(1+\frac{1}{\xi}\right)}$ is the density function of the GPD distribution if $\xi \neq 0$ and $1+\xi/\alpha y > 0$. When the GPD distribution and its parameters are estimated, we continue by calculating VaR_p quantiles of the underlying return distribution F_R which can be written as

$$F_R(u+y) = (1-F_R(u))F_u(y) + F_R(u). \qquad (12)$$

Note that $F_R(u)$ can be written as $(n-N_u)/n$ where n is the total number of returns and N_u is the number of returns above the threshold u, and that $F_u(y)$ can be replaced by $G_{\xi,\alpha}(y)$ (as well as rewriting $u+y$ as x), this expression can be simplified to

$$F_R(x) = 1-\frac{N_u}{n}\left(1+\frac{\xi}{\alpha}(x-u)\right)^{-\frac{1}{\xi}}. \qquad (13)$$

By inverting this expression, we get an expression for (unconditional) VaR_p quantiles associated with certain probabilities p:

$$VaR_p = u + \frac{\alpha}{\xi}\left(\left(\frac{n}{N_u}p\right)^{-\xi} - 1\right). \qquad (14)$$

3. Empirical Implementations and Backtesting

To valid the appropriateness of alternative risk models in this study, we backtest

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the underlying models on the historical log return series of three major U.S. futures markets, Nasdaq Index future, S&P 500 Index future and Natural Gas future over the period from Jan. 1997 to Dec. 2001. The plot of sample future indexes and their return series in Figure 1 to 3 shows that an existence of stress, high volatility, in 2001 during the internet bubble. In our implementation, we follow McNeil et al. (2000) and set 1000 daily returns for the estimation period, an approximation of 4- year duration, and reestimate the model with a one-day sliding window for the testing period from Jan., 2001 to Dec., 2001. More specifically, we reestimate the above various models using the past 1000 days' returns. Using each of the estimates of the underlying models, we produce (1-day) VaR_p forecasts for the following day.

These VaR_p forecasts are then compared to the actual return in the particular day. Several procedures can be utilized to valid the accuracy of an EVT-based VaR; however, for practical purpose, we adopt the way enacted by Basel Committee in 1998 (McNeil et al., 2000; Longin, 2000). The current verification procedure consists of recording daily violations of the 99 percent VAR over the last year. More specifically, one would expect on average one percent o 250, or 2.5 instances of violations (or exception) over the last year (Jorion,, 2002). An exception is said to occur when the actual loss is larger than the forecasted VaR_p . Therefore, the number of exception is refers to as the number of days when the actual loss is larger than the forecasted VaR_p. The Basel committee has regulated that up to four exceptions are acceptable, which defines as green light zone with no corrective action. If the number of exceptions is five or more, the underlying financial institution falls into a yellow or red zone and is subject to progressive penalty.

To ensure the appropriateness of using GARCH family models, we perform a careful preliminary check on the characteristics of the returns in the sample futures markets. For comparison, key descriptive statistics including mean, medians, maximum, minimum, standard deviations, Skewness, Kurtosis, Jarqu-Bera test, results of Augmented Dickey Fuller (ADF) tests, and results of ARCH effect tests, for three sample return series are summarized in table 1. The kurtosis estimates of Nasdaq, S&P 500 and natural gas are 6.98, 5.82 and 6.07, respectively. This highlight that our sample returns are far from normal distributed. The P-values of Jarque-Bera normality tests for the three sample returns further confirm the non-normality at high level of statistical significance. The sample sleekness of Nasdzq and S&P 500 are -0.22 and -0.12, respectively. This indicates that the asymmetric tails extends more towards negative value than positive value. Overall, high excess kurtosis, high skewness and highly significant Jarque-Bera statistics evidently indicate the sample returns are not normaly distributed. The statistics of the ADF tests on the unit roots indicates that all of sample returns are stationary financial time series at highly statistical significant

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level. Moreover, the statistics of the ARCH-LM test are 189.69, 71.76 and 35.88, for return series of Nasdaq, S&P 50 and Natural gas, respectively. Their significant p-values show that the three sample returns present the volatility clustering behaviors and hence conclude that the usage of GARCH family model is appropriate. Finally, Table 2 reports the estimation of asymmetric terms in four asymmetric GARCH models. The estimates of all asymmetric volatility models, GJR and EGARCH, in the table are all highly significant at reasonable levels. This conclusion also further confirmed by the sign and bias test. This evidence further lends to the support of using GJA and EGARCH models in the study.

For the tail estimation with POT method, tail index, ξ, is estimated by fitting GPD to the sample data. The results are presented in table 3. The estimated tail value ranges from 0.013 to 0.021, 0.014 to 0.027, and 0.074 to 0.101, for Nasdaq, S&P 500 and Natural gas, respectively. These values are greater than zero and highlight that all of them are fat-tailed distributions. This reconfirms the appropriateness of our EVT-based approach.

Finally, the relative performance of each model with one 1-day at 99% quantize VaR are summarized as number of exceptions (or violations) in Table 4. All of our proposed alternative models outperform the traditional EVT-based GARCH model, GARCH+GPD, in two stock index future markets. Note that the number of exceptions is 4 for the traditional EVT-based GARCH model in all sample return series. This is fall into the yellow zone and might result into a penalty under the current Basel Accord. Therefore, the performance of traditional EVT-based GARCH model is relative poor in comparison to our alterative models. Especially, those models adding trading volume do improve the accuracy of in all sample markets. In particular, the asymmetric type GARCH models incorporation with trading volume, namely, GJR+GPD+V model provide the best estimate than the others in terms of violation ratios. The same conclusion also applies to the result based on accuracy of forecasting via RMSE in Table5.

4. Summary and conclusions

Following the pioneer works of Diebold et al. (1999), McNeil et al. (2000) and Longing (2000), the dynamic EVT-based GARCH family model has evolved as a favored approach in measuring the market risks in the risk management literature. On the other hand, trading volume has well-documented as a important determinant in the assets pricing literature. Nerveless, previous works in the estimation of market risk ignore the importance and fail to account for the variable in the risk valuation process. The objective of this study is to formulate alterative models which adding trading

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volume as an explanatory variable in variance equations. In particular, this study extends previous works in two ways: (1) adding asymmetric GARCH family models to account for the possible asymmetric volatility effects; (2) departing from the traditional EVT-based GARCH family frameworks, this study formulate models that account for the trading volume of futures market. Our empirical implementation proceeded in two-stages. First of all, GARCH family models are established to filter the three sample return series in three U.S. major future markets. Second, we consider the standardized residuals computed in stage 1 to be realizations of a white noise process, and estimate the tails of innovations using POT.

Using alternative dynamic EVT-based GARCH family VaR models including GARCH+GPD+V, GJR+GPD+V and EGARCH+GPD+V, over the period from Jan. 1997 to Dec 2001, the study examine the value at risk of three major US futures markets, NASDAQ INDEX, S&P 500 INDEX and NATURAL GAS. Consistent with our a-priori expectation, the finding indicates that the proposed alternative dynamic EVT-based Asymmetric GARCH model; in general, outperform the traditional standard dynamic EVT-based GARCH type VaR model. Moreover, an incorporation of trading volume in the model improve the accuracy of VaR estimation. In particular, GJR+GPD+V is the best model among the others in terms of both rate of violation and Root Mean Square Errors (RMSE).

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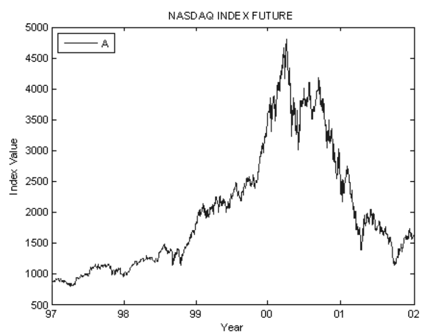
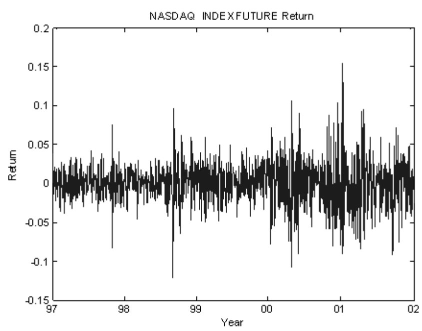
Appendix





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서식 있음: 글꼴 색: 자동
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삭제됨: ↵
서식 있음 ... [79]
서식 있음: 글꼴: 굵게

Figure 1.Time Series and Return Series of Nasdaq Index future

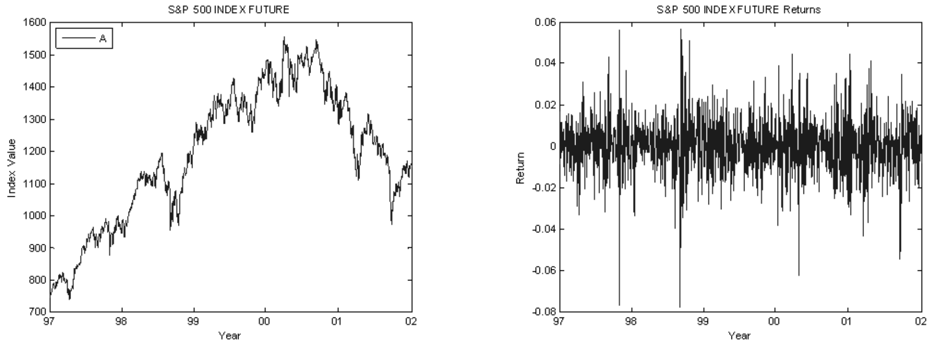

Figure 2.Time Series and Return Series of S&P 500 INDEX future

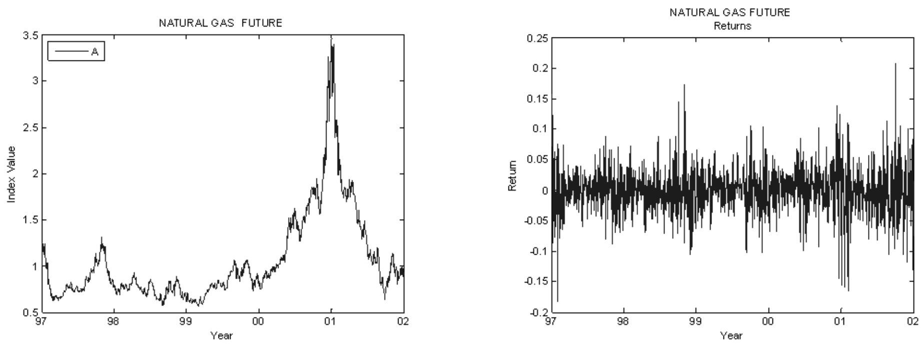

Figure 3.Time Series and Return Series of NATURAL GAS future

Table 1. Descriptive statistics and diagnostics of the log daily returns

Future Index	NASDAQ	S&P 500 INDEX	NATURAL GAS
Mean	0.000551	0.000437	0.000630
Median	0.001238	0.000478	0.000000
Maximum	0.167013	0.058176	0.231148
Minimum	-0.11512	-0.07468	-0.16744
Std. Dev.	0.022236	0.013517	0.038116
Skewness	-0.224135	-0.125803	0.237519
Kurtosis	6.986243	5.822081	6.077583
Jarque-Bera Test	1686.211 (0.000)***	420.103 (0.000)***	504.6574 (0.000)***
ADF Unit Root Test	-27.936 (0.000)***	-36.276 (0.000)***	-38.249 (0.000)***

서식 있음: 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.02 글자, 첫 줄: -1.02 글자, 눈금에 맞춤

서식 있음: 양쪽

ARCH Effect Test	189.698 (0.000)***	71.764 (0.000)***	35.883 (0.000)***

Note: P-values are in parentheses.

***,**and* indicate level of statistics at 1%, 5% and 10% respectively.

서식 있음: 들여쓰기: 첫 줄: 2.5 글자

Table 2. Estimation of asymmetric terms in alternative models

서식 있음: 글꼴 색: 자동

서식 있음: 양쪽

Future Index	NASDAQ	S&P 500 INDEX	NATURAL GAS
EGARCH	-0.4140 (0.000)***	0.83059 (0.000)***	0.03773 (0.0293)**
EGARCH+V	0.06121 (0.000)***	0.94071 (0.000)***	0.9893 (0.000)***
GJR	0.06786 (0.000)***	0.22965 (0.000)***	0.00238 (0.0449)**
GJR+V	0.93908 (0.000)***	0.21660 (0.000)***	0.89408 (0.000)***

Note: P-values are in parentheses.

***,**and* indicate level of statistics at 1%, 5% and 10% respectively.

서식 있음: 들여쓰기: 첫 줄: 2.5 글자

Table 3. Estimation of tail indices

서식 있음: 글꼴 색: 자동

서식 있음: 왼쪽, 들여쓰기: 첫 줄: 0 글자

Future Index	NASDAQ	S&P 500 INDEX	NATURAL GAS
GARCH	0.02116	0.01949	0.10105
GARCH+V	0.02162	0.01707	0.09383
EGARCH	0.01311	0.02220	0.10148
EGARCH+V	0.01969	0.01469	0.07413
GJR	0.01514	0.02663	0.09984
GJR+V	0.01676	0.02733	0.09760

서식 있음: 글꼴 색: 자동

서식 있음: 글꼴 색: 자동

서식 있음: 글꼴 색: 자동

서식 있음: 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.02 글자, 첫 줄: -1.02 글자, 눈금에 맞춤

Table 4. Number of exceptions of forecasted 1-day 99% VaRs

서식 있음: 왼쪽

Future Index	NASDAQ	S&P 500 INDEX	NATURAL GAS
GARCH+GPD	4	2	4
EGARCH+GPD	2	2	4
GJR+GPD	2	2	3
GARCH+GPD+V	2	2	4
EGARCH+GPD+V	2	2	2
GJR+GPD+V	2	1	2

Table 5. RMSE(%) of forecasted 1-day 99% VaRs

서식 있음: 양쪽

서식 있음: 글꼴 색: 자동

Future Index	NASDAQ	S&P 500 INDEX	NATURAL GAS
GARCH+GPD	4.98	3.99	4.33

EGARCH+GPD	4.41	3.90	4.18
GJR+GPD	4.24	3.96	4.13
GARCH+GPD+V	4.17	3.91	4.21
EGARCH+GPD+V	3.89	3.65	4.09
GJR+GPD+V	3.78	3.87	3.95

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서식 있음: 글꼴: 굵게 없음
삭제됨: Fung, H. G. and ... [81]
삭제됨: 27, 1801-1831. ... [82]
서식 있음 ... [83]
삭제됨: Vol.
서식 있음 ... [84]
삭제됨: Vol.
삭제됨: 27, 635-653. ... [85]
삭제됨: Vol.
삭제됨: 28, 95-974. ... [86]
삭제됨: Vol.
삭제됨: 81, 637-654. ... [87]
삭제됨: Vol.
삭제됨: 31, 307-327. ... [88]
삭제됨: Vol.
삭제됨: 131, 123-150. ... [89]
삭제됨: Vol.
삭제됨: 32, No. 5, 169 ... [90]
삭제됨: Vol. No.
삭제됨: 15, 907-918. ... [91]
삭제됨: Vol.
삭제됨: 7, 47-31. ... [92]
삭제됨: Vol.
삭제됨: 7, 31-40. ... [93]
삭제됨: Vol.
삭제됨: 27, 1045-1068. ... [94]
삭제됨: Vol.
삭제됨: 366, 449-462. ... [95]
삭제됨: Vol.
삭제됨: 10, 1-27. ... [96]
삭제됨: Vol.
삭제됨: 10, 75-87. ... [97]
삭제됨: Vol.
삭제됨: 32,
삭제됨: No.
삭제됨: 2, 463-478. ... [98]
삭제됨: Vol.
삭제됨: Vol.
삭제됨: 4, 289-322. ... [99]
삭제됨: 7, 283-330. ... [100]
삭제됨: Vol.
삭제됨: 50, 53-58. ... [101]
삭제됨: Vol.
삭제됨: 9, 53-69. ... [102]
삭제됨: Vol.
삭제됨: 8, 67-75. ... [103]
삭제됨: Vol.
삭제됨: 17, 144-170. ... [104]
삭제됨: Vol.
삭제됨: 30, 61-80. ... [105]
삭제됨: Vol.
삭제됨: 47, 1259-128 ... [106]
... [107]
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페이지 1: [1] 삭제됨	unknown\	2008-02-29 AM 11:48:00

Moreover, more recent bond valuation studies have clearly demonstrated that credit risk is an important factor related to the profitability of a convertible bond portfolio. The objective of this study is to formulate an option-based dynamic hedging model which accounts for credit risk for practitioners in managing convertible bond portfolio. This paper adopts four option-based dynamic delta-hedging models to account for the transaction costs and credit risk for convertible bond portfolio management. Departing from the traditional dynamic hedging strategy, this study incorporates the KD technical index to formulate a selective hedging strategy to account for asymmetric behavior of investors under bull and bear market conditions. Empirical investigations of five TSE-listed convertible bonds are provided to validate our proposed method. Consistent with the hedging literature, the valuation model with minimum tracking errors outperforms the others. In line with our expectation, transaction cost is an important issue. Moreover, the model takes into account theof credit risk which generates the highest profitability. Finally, an incorporation of the KD index as threshold hedging scenario considerably improves the profitability of the underlying CB portfolio.

페이지 1: [2] 삭제됨	unknown\	2008-02-29 PM 12:26:00

Option-based dynamic hedging

페이지 1: [3] 삭제됨	unknown\	2008-02-29 PM 12:27:00

Credit risk, CB portfolio

페이지 3: [4] 서식 있음	unknown\	2008-03-07 PM 5:59:00

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페이지 3: [5] 서식 있음	unknown\	2008-03-07 PM 5:59:00

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페이지 3: [6] 서식 있음	unknown\	2008-03-07 PM 5:59:00

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페이지 3: [7] 서식 있음	unknown\	2008-03-07 PM 7:24:00

양쪽, 들여쓰기: 첫 줄: 2 글자

페이지 3: [8] 서식 있음	unknown\	2008-03-07 PM 7:24:00

양쪽, 들여쓰기: 첫 줄: 2 글자

페이지 4: [9] 삭제됨	unknown\	2008-03-07 AM 10:26:00

Section 3 discusses
the estimated results for each model, and compares the finding with the existing
literature. Section 4 contains concluding remarks.

페이지 4: [10] 삭제됨	unknown\	2008-03-07 PM 6:00:00

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페이지 4: [11] 서식 있음	unknown\	2008-03-07 PM 6:40:00

글꼴: 굵게, 글꼴 색: 자동

페이지 4: [12] 삭제됨	unknown\	2008-03-07 PM 6:01:00

페이지 4: [13] 서식 있음	unknown\	2008-03-07 PM 6:40:00

글꼴: 굵게, 글꼴 색: 자동

페이지 4: [14] 삭제됨	unknown\	2008-03-07 AM 10:33:00

II. Data and Methodology

페이지 5: [15] 삭제됨	unknown\	2008-03-07 PM 4:32:00

2.1 Modelling the tails of stock return distributions

Traditional methods to estimate the tail distribution under EVT theory can be divided into two groups: the peaks over threshold (POT) method which looks at those events in the data that exceed a high threshold, and block maxima method (BMM) which divides the data into consecutive blocks and focuses on the series of maxima (or minima) in these blocks (Embrechts et al., 1997; Kellezi & Gilli, 2000; McNeil, 1998; Bystrom (2004)). Bystrom (2004) suggest that both BMM and POT generate similar results in estimating and forecasting both conditional and unconditional VaR. Nerveless, BMM requires long histories for estimation. Therefore, this study adopts POT method to estimate the underlying VaRs.

Under POT method, we collect those returns in the sample series that exceed a certain high threshold, u, and model these returns separately from the rest of the distribution. Note that the choice of threshold value, u, is the most important implementation issue in EVT, McNeil et al.(2000) set 10 as the value of threshold, u, after a careful simulation. Following their study, we set 10 as our threshold value in our empirical implementation at backtesting stage.

As Bystrom (2004), we start by calling a daily return in our data series R and assume that it comes from a distribution F_R. The returns above the threshold u then follow the excess distribution $F_u(y)$ that is given by

$$F_u(y) = P(\text{R-}u \leq \text{y} \mid \text{R} > u) = \frac{F_R(u+y) - F_R(u)}{1 - F_R(u)}, \qquad 0 \leq y \leq R_F - u \tag{1}$$

where y is the excess over u, and R_F is the right endpoint of F_R. If the threshold, u, is high enough, Balkema et al. (1974) and Pickands (1975) show that for a large class of distributions, F_R, the excess distribution, $F_u(y)$, can be approximated by the so-called generalized Pareto distribution (GPD), which can be formulated as

$$\lim_{u\uparrow} \sup_{0 \leq y \leq R_F - u} \left| F_u(y) - G_{\xi,\beta}(y) \right| = 0 \tag{2}$$

$$G_{\xi,\alpha}(y) = \left[1 - (1 + \frac{\xi}{\alpha} y) \right]^{\frac{-1}{\xi}} \qquad \text{,if } \xi \neq 0$$

$$G_{\xi,\alpha}(y) = 1 - e^{\frac{-y}{\alpha}} \qquad \text{,if } \xi = 0 \tag{3}$$

for $0 \leq y \leq R_F - u$. ξ is the tail index and for the fat-tailed distributions found in finance, one can expect a positive ξ. α is just a positive scaling parameter. Empirically, the tail index, ξ, as well as the scaling parameter, α, have to be determined by fitting the GPD to the actual data. These parameters are estimated via the maximum likelihood method:

$$\max L_G(\xi, \alpha; \text{y}) = \max \sum_i \ln\left(g_{\xi,\alpha}(y_i)\right), \tag{4}$$

where $g_{\xi,\alpha}(y) = \frac{1}{\alpha}(1 + \frac{\xi}{\alpha} y)^{-\left(1+\frac{1}{\xi}\right)}$ is the density function of the GPD distribution if $\xi \neq 0$ and $1+\xi/\alpha y > 0$. When the GPD distribution and its parameters are estimated, we continue by calculating VaR_p quantiles of the underlying return distribution F_R which can be written as

$$F_R(u+y) = (1-F_R(u))F_u(y) + F_R(u)\,. \tag{5}$$

Note that $F_R(u)$ can be written as $(n-N_u)/n$ where n is the total number of returns and N_u is the number of returns above the threshold u, and that $F_u(y)$ can be replaced by $G_{\xi,\alpha}(y)$ (as well as rewriting $u+y$ as x), this expression can be simplified to

$$F_R(x) = 1 - \frac{N_u}{n}\left(1+\frac{\xi}{\alpha}(x-u)\right)^{-\frac{1}{\xi}}. \tag{6}$$

By inverting this expression, we get an expression for (unconditional) VaR_p quantiles associated with certain probabilities p:

$$VaR_p = u + \frac{\alpha}{\xi}\left(\left(\frac{n}{N_u}p\right)^{-\xi} - 1\right). \tag{7}$$

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글꼴 색: 자동

페이지 11: [16] 서식 있음	unknown\	2008-03-07 PM 6:22:00

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페이지 11: [17] 서식 있음	unknown\	2008-03-07 PM 6:22:00

글꼴 색: 자동

페이지 11: [17] 서식 있음	unknown\	2008-03-07 PM 6:22:00

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페이지 11: [18] 삭제됨	unknown\	2008-03-07 PM 4:34:00

Following the pioneer work of Bollerslev (1986, 1992), the GARCH class has become a superior model in assessing the stochastic volatility of financial instruments (Gerlach *et al.*, 2006). The literature on the valuation of CB has documented that the exponential GARCH models have some advantages over the GARCH class of models (Nelson (1991), Vetzal (1997)). For simplicity, we adopt standard GARCH(1,1) model to capture the stochastic return volatility of the underlying assets. The GARCH model can be formulated as follows:

Convertible bonds (CBs) are sophisticated financial instruments and widely traded in the Taiwan's capital market. The static hedging of CB was a standard trading strategy of more sophisticated Taiwanese investors in the past few years. However, the profitability of such a strategy has been eroded resulting fro

페이지 11: [19] 삭제됨	unknown\	2008-03-07 PM 4:34:00

m price change in underlying stock due to recent regulatory change on the conversion practice of CBs in 2003. In contrast to the static hedging strategy which is subject to the risk exposure of price change in the underlying stocks, the dynamic hedging strategy could eliminate the risk of price changes in the underlying stocks. Thus, the latter is evolving as a preferred trading strategy in

페이지 11: [20] 삭제됨	unknown\	2008-03-07 PM 4:34:00

Taiwan's capital market.

Yet, valuation literature presents a variety of model specifications for CBs with no conclusive finding on the best model. Moreover, the traditional approach failed to account for default risks of CB issuers. More recent studies of bonds have clearly demonstrated that credit risk indeed affects the profitability of a convertible bond portfolio (Tong, 1995; Krueger, 1999; Hung *et al.*, 2002; Meyer, 2003; Beltratti, 2004). The objectives of this study are two-fold: first, to investigate which model is more appropriate for convertible bond valuation; second, to formulate a dynamic hedging strategy for convertible bond practitioners. This paper adopts

페이지 11: [21] 삭제됨	unknown\	2008-03-07 PM 4:34:00

four option-based dynamic delta-hedging models

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that account for the transaction costs and credit risk for convertible bond portfolio management. Departing from the traditional dynamic hedging strategy, this study extends the previous study by incorporating the KD technical index to formulate a selective hedging strategy to account for asymmetric behavior of investors under bull and bear market conditions. Empirical investigations of five TSE-

페이지 11: [23] 삭제됨	unknown\	2008-03-07 PM 4:34:00

listed convertible bonds are provided to demonstrate the feasibility of our proposed method. Consistent with the hedging literature, the valuation model with minimum tracking errors outperforms the others. In line with our expectation, transaction cost is an important issue. Moreover, the model takes into account the

페이지 11: [24] 삭제됨	unknown\	2008-03-07 PM 4:34:00

which generates the most attractive profitability. Finally, application of the KD index enhances the profitability of the underlying portfolio.

The remainder of this paper is organized as follows. Section 2 presents a review of the relevant literature on bond valuations. Section 3 provides a discussion of the experiment design in the study, which is followed in section 4 by an evaluation of the model via numerical examples. The paper concludes with a summary analysis of the findings in section 5.

II. Brief review of the literature

The value and hedge of a CB is sophisticated because of the nature

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of having many embed options. Traditional methods of pricing a convertible bond decompose value of a CB into the value of a straight bond and the conversion value. The optimal value of a convertible bond at any time before its maturity can be obtained by the discounted value of the straight bond and the conversion value that is higher. It can be formulated as:

$$\text{Value of CB}=\frac{\max(\text{straight value, conversion value})}{\text{discount rate}}$$

The optimal time for the holder to exercise the conversion option is when the conversion value exceeds its market value. This method has been widely used by Poensgen (1965), Baumol *et al.* (1966), Weil *et al.* (1968) Walter *et al.* (1973) and Jennings (1974). The traditional method has serious shortcomings and tends to under-estimate the intrinsic value of a CB (Ingersoll,

페이지 11: [26] 삭제됨	unknown\	2008-03-07 PM 4:34:00

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There are two other distinctive approaches to value a CB. The first type is the contingent-claim approach. This more sophisticated approach values the convertible bond as a sum of a straight bond and a call option on the underlying stock. The pioneer of this approach can be traced back to the work of Black and Scholes (1973). They established the price of a

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European call option through a well known formula, which is the solution to a second order partial differential equation. This closed analytical solution conferred elegance to the proposed formulation and multiplied in extensive and complementary studies. However, Ingersoll (1977) indicated that the embed option of a convertible bond is of the American type. Thus, the risk discount rate can not be determined easily. Ingersoll (1977), who assumes the specific stochastic process of interest rate and underlying equity price and then applied Ito's

페이지 11: [28] 삭제됨	unknown\	2008-03-07 PM 4:34:00

lemma to derive a partial differential

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? equation and priced the CB with closed-form solution. Among the others, Brennan and Schwartz (1977, 1980) extend the previous work by incorporating arbitrage-free argument and exploiting the appropriate boundary conditions. Then, they price CB by solving the partial differential equation. Since the work by Ingersoll (1977) and Brennan *et al.* (1977), the contingent-claims approach to pricing CBs is the norm. However, the presence of senior debts and multiple classes of common stocks in a capital structure of a firm makes this approach difficult to capture the value of a CB (Brrone-Adesi *et al.* 2003). In addition, this method is not exact, since the exercise price on the equity option is not fixed. Recently, Gong *et al.* (2006) adopted the finite difference method to solve the Black and Scholes equation through a multi-stage compound-option model and provide

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evidence to support the assertion that finite difference method generates higher accuracy and efficiency.

The second type

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is the traditional binomial (or tree) approach. To price a CB under this approach, the first step is to determine the payoff at the terminal nodes of the stock price tree, and subsequently roll back to the initial node to obtain the price of the underlying CB. This approach has been widely used in

페이지 11: [32] 삭제됨	unknown\	2008-03-07 PM 4:34:00

.

The recent CB valuation literature has focused on the price effect of a default risk or, more specifically, the potential price change resulting from default of an issuing firm (Tong,

페이지 12: [33] 삭제됨	unknown\	2008-03-07 PM 4:43:00

n option-based dynamic hedging model which accounts for credit risk for practitioners in managing convertible bond portfolio.

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paper

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adopts four option-based dynamic

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delta-hedging models t

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n costs and credit risk for convertible bond portfolio management

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Departing from the traditional dynamic hedging strategy, this study incorporates the KD technical index to formulate a selective hedging strategy to account for asymmetric behavior of investors under bull and bear market conditions.

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four option-based models are

페이지 12: [33] 삭제됨 unknown\ 2008-03-07 PM 4:50:00

estimate the Delta value

페이지 12: [33] 삭제됨 unknown\ 2008-03-07 PM 5:00:00

appropriate hedge ratios are calculated to rebalance bond portfolio to circumvent the risk of price change in the underlying securities.

페이지 12: [34] 삭제됨 unknown\ 2008-03-07 PM 5:32:00

Empirical investigations of five TSE-

페이지 12: [35] 삭제됨 unknown\ 2008-03-07 PM 5:32:00

listed convertible bonds are provided to demonstrate the feasibility of our proposed method. Consistent with the literature in dynamic hedging, the valuation model with minimum tracking errors outperforms the others, and dynamic delta hedging in our CB portfolio produces significant positive return (Krishnan *et al.*,

페이지 12: [36] 삭제됨	unknown\	2008-03-07 PM 5:32:00

). In line with our expectation, transaction cost is an important issue as documented by Gondzio et al. (2003). Moreover, the model takes into account

페이지 12: [37] 삭제됨	unknown\	2008-03-07 PM 5:32:00

credit risk, which generates the most attractive profitability. In comparison to the dynamic traditional hedging strategy, our scenario modeling for selective hedging with incorporation of KD as threshold variable could considerably improve performance of CBs. Overall, our results further sh

페이지 12: [38] 삭제됨	unknown\	2008-03-07 PM 5:32:00

light on the application technical trading strategies

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practitioners in CB investment management.

페이지 12: [40] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [41] 서식 있음	user	2008-03-07 PM 10:34:00

표준, 양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.28 글자, 첫 줄: -1.28 글자

페이지 12: [42] 서식 있음	unknown\	2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음	unknown\	2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음	unknown\	2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음	unknown\	2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음	unknown\	2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [42] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [42] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

서식 있음

페이지 12: [42] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

서식 있음

페이지 12: [43] 서식 있음 user 2008-03-07 PM 10:34:00

양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.4 글자, 첫 줄: -1.4 글자

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 기울임꼴, 글꼴 색: 자동

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [44] 서식 있음 unknown\ 2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 기울임꼴, 글꼴 색: 자동

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 기울임꼴, 글꼴 색: 자동

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: 기울임꼴

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [44] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 12: [45] 서식 있음	user	2008-03-07 PM 10:34:00

양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.4 글자, 첫 줄: -1.4 글자

페이지 12: [46] 서식 있음	user	2008-03-07 PM 10:34:00

지정한 문자 수와 상관없이 오른쪽 들여쓰기 하지 않음, 한글과 영어 간격을 자동으로 조절하지 않음, 한글과 숫자 간격을 자동으로 조절하지 않음

페이지 13: [47] 서식 있음	user	2008-03-07 PM 10:34:00

지정한 문자 수와 상관없이 오른쪽 들여쓰기 하지 않음, 한글과 영어 간격을 자동으로 조절하지 않음, 한글과 숫자 간격을 자동으로 조절하지 않음

페이지 13: [48] 서식 있음	user	2008-03-07 PM 10:34:00

들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.02 글자, 첫 줄: -1.02 글자, 눈금에 맞춤

페이지 13: [49] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: Times New Roman, 12 pt, 글꼴 색: 자동

페이지 13: [50] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: Times New Roman, 12 pt, 글꼴 색: 자동

페이지 13: [51] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: Times New Roman, 12 pt, 글꼴 색: 자동

페이지 13: [52] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [53] 서식 있음	user	2008-03-07 PM 10:34:00

양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.22 글자, 첫 줄: -1.22 글자, 지정한 문자 수에 맞춰 오른쪽 들여쓰기 자동 조정, 한글과 영어 간격을 자동으로 조절, 한글과 숫자 간격을 자동으로 조절

페이지 13: [54] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [55] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [56] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [57] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [58] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 13: [59] 서식 있음	user	2008-03-07 PM 10:34:00

지정한 문자 수와 상관없이 오른쪽 들여쓰기 하지 않음, 한글과 영어 간격을 자동으로 조절하지 않음, 한글과 숫자 간격을 자동으로 조절하지 않음

페이지 13: [60] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (한글) AdvTimes

페이지 15: [61] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [62] 서식 있음	user	2008-03-07 PM 10:34:00

양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.22 글자, 첫 줄: -1.22 글자, 지정한 문자 수에 맞춰 오른쪽 들여쓰기 자동 조정, 한글과 영어 간격을 자동으로 조절, 한글과 숫자 간격을 자동으로 조절

페이지 15: [63] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [64] 서식 있음	user	2008-03-07 PM 10:52:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 기울임꼴, 글꼴 색: 자동

페이지 15: [65] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [66] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [67] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [68] 서식 있음	user	2008-03-07 PM 10:34:00

들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.1 글자, 첫 줄: -1.1 글자

페이지 15: [69] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (한글) AdvTimes

페이지 15: [70] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [71] 서식 있음	user	2008-03-07 PM 10:34:00

양쪽, 들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.22 글자, 첫 줄: -1.22 글자, 지정한 문자 수에 맞춰 오른쪽 들여쓰기 자동 조정, 한글과 영어 간격을 자동으로 조절, 한글과 숫자 간격을 자동으로 조절

페이지 15: [72] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [73] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [74] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [75] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [76] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [77] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [78] 서식 있음	unknown\	2008-03-07 PM 7:20:00

글꼴: (영어) Times New Roman, (한글) PMingLiU, 12 pt, 글꼴 색: 자동

페이지 15: [79] 서식 있음	unknown\	2008-03-07 PM 5:20:00

들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.02 글자, 첫 줄: -1.02 글자, 눈금에 맞춤

페이지 18: [80] 서식 있음	unknown\	2008-03-07 PM 5:20:00

들여쓰기: 왼쪽: 0 cm, 내어쓰기: 1.02 글자, 첫 줄: -1.02 글자, 눈금에 맞춤

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페이지 18: [82] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:20:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:20:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: Times New Roman, 12 pt

페이지 18: [83] 서식 있음	unknown\	2008-03-07 PM 5:16:00

글꼴: 12 pt

페이지 18: [84] 서식 있음	unknown\	2008-03-07 PM 5:19:00

표준, 양쪽, 들여쓰기: 왼쪽: 0 cm, 첫 줄: 0 글자, 지정한 문자 수와 상관없이 오른쪽 들여쓰기 하지 않음, 한글과 영어 간격을 자동으로 조절하지 않음, 한글과 숫자 간격을 자동으로 조절하지 않음, 눈금에 맞추지 않음

페이지 18: [85] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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페이지 18: [86] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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페이지 18: [87] 삭제됨	unknown\	2008-03-07 PM 5:19:00

81, 637-654.
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페이지 18: [88] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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페이지 18: [89] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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페이지 18: [90] 삭제됨	unknown\	2008-03-07 PM 5:19:00

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