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# The Efficacy of Value at Risk Models in Caribbean Equity Markets

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- Introduction
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- Results
- Conclusions

- Global financial and European Sovereign debt crises have underscored necessity for more robust and dynamic financial risk management metrics.
- One such tool is Value at Risk (VaR) model.
- The VaR is the estimated loss from a fixed set of trading positions over a fixed time horizon that would be equaled or exceeded with a specified probability.
- VaRs have performed relatively well in developed financial markets.

# Introduction (cont'd)

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- No known studies addressing VaR modeling in the Caribbean.
- This paper evaluates efficacy and applicability of VaR models in emerging equity markets of the Caribbean.
- Recommendations on how existing VaR models may be enhanced to increase their usefulness within Caribbean context.

- VaR models constructed from daily returns data of stocks on four stock exchanges: BSE, ECSE, JSE and TTSE.
- Stock returns derived from the following specific indices:
  - Local Index on BSE
  - EC-Share Index on ECSE
  - Market Index on JSE
  - Composite Index on the TTSE.

# Data and methodology (cont'd)

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- Daily return data for period January 2005 to July 2008 (sample period) used to construct VaR models using historical and parametric methods under the assumption of constant, unconditional variation.
- Efficacy of each VaR tested at 95% and 99% confidence levels within this period as well as within an “out-of-sample” period, August 2008 to July 2009.
- Efficacy of historical and parametric VaR models also evaluated within the out-of-sample period under the assumption of conditional or “time-varying” volatility.

## Data and methodology (cont'd)

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- Models compared against one another and the most effective VaR model for each stock market identified and recommended.
- Assumption of a 5 business day week was used.
- On public holidays and in instances of 3 day trade week, assumed that price remained the same as previous day's closing price.

# Data and methodology (cont'd)

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- Efficacy of VaR models constructed using data for sample period evaluated through “backtesting” using two different criteria.
  - Actual exception rate (also called failure rate) is tested to ensure that it is less than or equal to the expected exception rate using a fully non-parametric approach.
  - Root Mean Square Error (RMSE) criterion: the lower the RMSE, the more effective is the VaR model.

- These two criteria also used to determine the efficacy of VaR in out-of-sample period
- Two other criteria are used as well.
  - Test used to verify the results of the first test recommended by Kupiec (1995)
  - $R^2$  obtained from the following regression, in which  $r^2$  is squared returns and  $h^2$  is volatility predicted by the VaR model with conditional volatility:

$$\log(r^2_t) = \alpha + \beta \log(h^2_t) + u_t$$

The higher the  $R^2$ , the more effective the model at forecasting actual volatility.

# Data and methodology (cont'd)

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- VaR models satisfying first two criteria in out-of-sample period ranked using a simple efficacy ratio
  - $R^2$  divided by the RMSE.
- This ratio quantifies volatility predictive power per dollar of RMSE.
- Most effective VaR models have an actual exception rate that is less than or equal to the expected exception rate.
- Possesses ability to maximize accuracy of its forecasts of realized volatility ( $R^2$ ) whilst simultaneously minimizing the error of its forecasts (RMSE).

# Results (BSE)

VaR Model	Volatility	Effective	Efficacy Ratio	Rank
HS VaR 95%	Constant	No	NA	NA
HS VaR 99%	Constant	No	NA	NA
P VaR 95%	Constant	Yes	0.000381	1
P VaR 99%	Constant	Yes	0.000299	2
HS VaR 95%	260d rsd	Yes	0.000211	3
HS VaR 95%	22d rsd	No	NA	NA
HS VaR 99%	260d rsd	No	NA	NA
HS VaR 99%	22d rsd	No	NA	NA
P VaR 95%	260d rsd	Yes	0.000170	4
P VaR 95%	22d rsd	Yes	0.000012	9
P VaR 95%	EWMA	Yes	0.000052	8
P VaR 95%	GARCH(1,1)	Yes	0.000065	7
P VaR 99%	260d rsd	No	NA	NA
P VaR 99%	22d rsd	No	NA	NA
P VaR 99%	EWMA	Yes	0.000096	5
P VaR 99%	GARCH(1,1)	Yes	0.000096	5

## Results (ECSE)

VaR Model	Volatility	Effective	Efficacy Ratio	Rank
HS VaR 95%	Constant	No	NA	NA
HS VaR 99%	Constant	Yes	0.000000	8
P VaR 95%	Constant	No	NA	NA
P VaR 99%	Constant	Yes	0.005864	1
HS VaR 95%	260d rsd	Yes	0.000199	5
HS VaR 95%	22d rsd	No	NA	NA
HS VaR 99%	260d rsd	Yes	0.001097	4
HS VaR 99%	22d rsd	No	NA	NA
P VaR 95%	260d rsd	No	NA	NA
P VaR 95%	22d rsd	Yes	0.001823	3
P VaR 95%	EWMA	No	NA	NA
P VaR 95%	GARCH(1,1)	No	NA	NA
P VaR 99%	260d rsd	Yes	0.002265	2
P VaR 99%	22d rsd	No	NA	NA
P VaR 99%	EWMA	Yes	0.000153	6
P VaR 99%	GARCH(1,1)	Yes	0.000153	6

## Results (JSE)

VaR Model	Volatility	Effective	Efficacy Ratio	Rank
HS VaR 95%	Constant	Yes	0.000000	11
HS VaR 99%	Constant	Yes	0.000000	11
P VaR 95%	Constant	Yes	0.000005	4
P VaR 99%	Constant	Yes	0.000004	5
HS VaR 95%	260d rsd	Yes	0.000006	3
HS VaR 95%	22d rsd	No	NA	NA
HS VaR 99%	260d rsd	Yes	0.000001	8
HS VaR 99%	22d rsd	No	NA	NA
P VaR 95%	260d rsd	Yes	0.000015	1
P VaR 95%	22d rsd	No	NA	NA
P VaR 95%	EWMA	Yes	0.000003	6
P VaR 95%	GARCH(1,1)	Yes	0.000003	7
P VaR 99%	260d rsd	Yes	0.000010	2
P VaR 99%	22d rsd	No	NA	NA
P VaR 99%	EWMA	Yes	0.000000	9
P VaR 99%	GARCH(1,1)	Yes	0.000000	9

## Results (TTSE)

VaR Model	Volatility	Effective	Efficacy Ratio	Rank
HS VaR 95%	Constant	No	NA	NA
HS VaR 99%	Constant	No	NA	NA
P VaR 95%	Constant	No	NA	NA
P VaR 99%	Constant	No	NA	NA
HS VaR 95%	260d rsd	No	NA	NA
HS VaR 95%	22d rsd	No	NA	NA
HS VaR 99%	260d rsd	No	NA	NA
HS VaR 99%	22d rsd	No	NA	NA
P VaR 95%	260d rsd	No	NA	NA
P VaR 95%	22d rsd	No	NA	NA
P VaR 95%	EWMA	Yes	0.010401	2
P VaR 95%	GARCH(1,1)	Yes	0.010477	1
P VaR 99%	260d rsd	No	NA	NA
P VaR 99%	22d rsd	No	NA	NA
P VaR 99%	EWMA	No	NA	NA
P VaR 99%	GARCH(1,1)	No	NA	NA

- Parametric VaR models, which are based on the assumption that returns are normally distributed, are the most effective in all the markets in this study.
- This finding supported by work of Andjelic *et al.* (2010), which shows that the delta normal and historical simulation VaR models are successful at the 95% and 99% confidence levels in emerging equity markets of selected Central and Eastern European countries.

- Data provides evidence that the most effective VaR models are:
  - Parametric VaR (assuming constant volatility) in the BSE and ECSE
  - Parametric VaR (non-constant volatility using the 260-day rolling standard deviation) in JSE
  - Parametric VaR (assuming non-constant volatility using both the Exponentially Weighted Moving Average and a simple GARCH(1,1) model) in TTSE
- The parametric VaR was very effective in all markets.
- VaR models with time varying volatility more effective in the JSE and TTSE than in the BSE and ECSE.

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