Circular Model for Forecasting Returns of Bank, Finance, & Insurance Sector of the Sri Lankan Stock Market

W.G. S. Konarasinghe[1]

Introduction

Share trading is an important part of the economy of a country. Share market investments are high return, but also high risk. As such, scientific forecasting plays a vital role in share market. Previously, the Capital Asset Pricing Model (CAPM), Auto Regressive Integrated Moving Average (ARIMA) models and Vector Auto Regression (VAR) models were the main models tested across the world, but the Circular Model (CM) was developed more recently as a Univariate Statistical Model for forecasting share returns.

Problem Statement

The CAPM has been subjected to extensive empirical testing in the past few decades. Literature reveals that CAPM is unable to measure the return of Sri Lankan share market. Konarasinghe & Pathirawasam (2013) show that VAR models are not suitable in the Sri Lankan context. Konarasinghe, Abeynayake & Gunaratne (2015) show that ARIMA models are also not highly successful. It is Konarasinghe et al. (2016-a) who introduce the Circular Model (CM) for forecasting returns, demonstrating the success of CM in the context of the Sri Lankan share market. However, the authors recommend that the method is subject to further testing, as it is a newly developed technique. Bank Finance & Insurance (BFI) plays a vital role in an economy of a country. It is believed that the sector BFI of the Sri Lankan share market is highly volatile, and that as such returns are unpredictable.

Objective of the Study

This study focused on testing the suitability of CM in forecasting the returns of individual companies in the BFI sector .

Literature Review

The development of the Circular Model (CM) is based on the theory of Uniform Circular Motion and the Fourier transformation (Konarasinghe, 2016). The CM is given by the formula;

[1] *Institute of Mathematics and Management, Nugegoda, Sri Lanka sinasisi@gmail.com*

$$R_t = \sum_{k=1}^{n} (a_k \sin k\omega t + b_k \cos k\omega t) + \varepsilon_t \quad (1)$$

Where; R_t is the return at time *t*, ω is the angular speed, a_k and b_k are amplitudes, k is the harmonic of oscillation.

As explained by Konarasinghe (2016), model assumptions are; trigonometric series $\sin k\omega t, \cos k\omega t$ are independent; residuals (ε_t) are normally distributed and independent. The model is applicable only if the R_t follows a wave like pattern.

Konarasinghe et al. (2016-a) have tested the CM on random sample of companies of the Colombo Stock Exchange (CSE). Results of the above study revealed that the CM was successful in forecasting monthly returns of Sri Lankan share market. Konarasinghe et al. (2016-b) have compared the forecasting ability of ARIMA and CM in Sri Lankan share market. They have concluded that CM is superior to ARIMA in Sri Lankan context. Konarasinghe et al. (2016-c) have shown that the CM is suitable in forecasting individual company returns of the Hotel & Travel sector of the CSE.

Methodology

The sector BFI of the CSE has 33 companies listed in year 2014. Among them, a simple random sample of ten companies was selected. Monthly average share prices for individual companies were calculated by using daily closing share prices from year 1991 to year 2014. Then, monthly returns were calculated by the formula;

$$R_t = \left(\frac{P_t - P_{t-1}}{P_{t-1}} \right) 100 \quad (2)$$

Where; P_t is the share price at month *t*.

The CM was tested on outlier adjusted series. Model validation was based on the Goodness of fit tests; Auto Correlation Functions (ACF) and Partial Autocorrelation Functions (PACF) of residuals, Ljung-Box Q statistics (LBQ) and Anderson Darling test. The absolute measures of errors; Mean Absolute Deviation (MAD) and Root Mean Squared Error (RMSE) were used to check the forecasting ability of fitted models.

Results & Discussion

The Circular model was tested on returns of the companies by using the program written by Konarasinghe, (2016); using the software MATLAB. The Angular speed (ω) for a company is calculated by;

$$\omega = 2\pi f / N \quad (3)$$

Where f is the number of peaks and N is the number of observations in the series. Then trigonometric series; $sink\omega t$ and $cos\ k\omega t$ for k is from 1 to 6 were obtained. The correlation analysis confirmed the independence of these series. Hence R_t was regressed on them. The summary of the analysis is given in Table1.

Table1: The Best Fitting Circular Models in Forecasting Returns of Sector BFI

Company	Best Fitting Model	Model Fitting		Model Verification		Remarks of Residuals
		RMSE	MAD	RMSE	MAD	
ALLI	$R_t = 1.48 + 0.60\cos\omega t$	7.07	5.45	6.85	5.34	Normal, Uncorrelated
ASIA	$R_t = -0.30 + 2.90\sin 4\omega t$	8.9	7.1	8.75	7.18	Normal, Uncorrelated
DFCC	$R_t = 0.31 - 2.03\cos 5\omega t$	8.3	6.5	6.06	4.96	Normal, Uncorrelated
HNB	$R_t = 0.77 - 1.60\sin 5\omega t - 1.28\cos 5\omega t$	5.7	4.4	4.3	3.5	Normal, Uncorrelated
LFIN	$R_t = -0.21 + 2.33\sin 6\omega t + 2.11\cos\omega t$	7.89	6.48	5.76	4.35	Normal, Uncorrelated
LOLC	$R_t = 1.00 + 1.90\cos 2\omega t$	9.7	7.6	8.8	6.8	Normal, Uncorrelated
HASU	$R_t = 1.08 - 2.10\sin 5\omega t$	6.7	5.3	5.7	4.4	Normal, Uncorrelated
SAMP	Model does not fit					
AMANA	Model does not fit					
AAIC	Model does not fit					

The CM was well fitted for seven out of the ten companies. Residuals of all the fitted models were normally distributed and independent. The MAD and RMSE of all the models were small in both model fitting and verification. Findings of the study revealed that the Circular Model is suitable in forecasting individual company returns of the sector BFI.

Conclusions & Recommendations

Forecasting is indispensable to a healthy stock market. The statistical models; CAPM, ARIMA, VAR, and ARCH/ GARCH were not successful in forecasting individual company returns in the Sri Lankan share market, but the CM has proven

successful in this context (Konarasinghe, 2016). This study focused on testing the CM on forecasting individual company returns of the sector BFI of the CSE.
The results of the study are consistent with the findings of Konarasinghe et al.

According to Konarasinghe (2016), the CM fills the knowledge gap in forecasting individual company returns of the Sri Lankan share market. Therefore the CM can be applied in the Sri Lankan context, instead of depending on CAPM which is not applicable to the Sri Lankan share market forecasting. However, the existing software; SPSS, MINITAB etc cannot be used for model testing and forecasting. The program written and published by Konarasinghe (2016) can be used for the purpose, but the MATLAB software is not freely available, and is also expensive. As such, it is necessary to develop software for the practical implementation of the CM.

Key Words: Circular Model, Fourier transformation

References

Konarasinghe, W.G.S. & Pathirawasam, C. (2013). Modeling Stock Returns and Trading Volume of Colombo Stock Exchange. *Sri Lankan Journal of Management*, 18, (3&4), 167-224

Konarasinghe, W.G.S., Abeynayake, N.R., Gunaratne, L.H.P, (2015). ARIMA Models on Forecasting Sri Lankan Share Market Returns. *International Journal of Novel Research in Physics, Chemistry and Mathematics*, 2(1), 6-12. Available at: www.noveltyjournals.com

Konarasinghe W.G.S (2016). Model Development for Stock Returns, PhD Thesis, Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

Konarasinghe, W.G.S., Abeynayake, N.R., Gunaratne, L.H.P, (2016-a). Circular Model on Forecasting Returns of Sri Lankan Share Market. *International Journal of Novel Research in Physics, Chemistry and Mathematics*, 3(1), 49-56. Available at: www.noveltyjournals.com

Konarasinghe, W.G.S., Abeynayake, N.R., Gunaratne, L.H.P, (2016-b). Comparison of ARIMA & Circular Model in Forecasting Sri Lankan Share Market Returns. *International Journal of Novel Research in*

Interdisciplinary Studies, 3(2), 3-8. Available at: www.noveltyjournals.com

Konarasinghe, W.G.S., Abeynayake, N.R., Gunaratne, L.H.P., (2016-c). Circular Methods on Forecasting Risk & Return of Hotel & Travel Sector of Sri Lankan Share Market. *Proceedings of International Conference on Business, Economics, Social Sciences & Humanities, Singapore,* 197, (14), 18.Available at: http://academicfora.com/