

## Measuring Stock Market Volatility in an Emerging Economy

**Rajni Mala**

*Faculty of Business and Economics  
University of the South Pacific, Fiji Islands*  
E-mail: Mala\_r@usp.ac.fj  
Tel: 679 3232089

**Mahendra Reddy**

*Faculty of Business and Economics  
University of the South Pacific, Fiji Islands*  
E-mail: Reddy\_m@usp.ac.fj  
Tel: 679 3232089

### Abstract

Volatility of returns in financial markets can be a major stumbling block for attracting investment in small developing economies. In this study, we use the Autoregressive Conditional Heteroskedasticity (ARCH) models and its extension, the Generalized ARCH model was used to find out the presence of the stock market volatility on Fiji's stock market. The analysis was done using a time series data for the period 2001-2005 on specific firms and it was found out that seven out of the sixteen firms listed on Fiji's stock market is volatile. The volatility of stock returns were then regressed against the interest rates and the results showed that the interest rates changes have a significant effect on stock market volatility. Using a priori theory and knowledge, the impact of factors like government regulations, low levels of liquidity on volatility were also derived.

**Keywords:** Volatility, Stock market, GARCH Model

**JEL Classification:** G12; C22; C32; C51, C52

### A. Introduction

A common problem plaguing the low and slow growth of small developing economies is the swallow financial sector. Financial markets play an important role in the process of economic growth and development by facilitating savings and channeling funds from savers to investors. While there have been numerous attempts to develop the financial sector, small island economies are also facing the problem of high volatility in numerous fronts including volatility of its financial sector.

Volatility may impair the smooth functioning of the financial system and adversely affect economic performance. Similarly, stock market volatility also has a number of negative implications. One of the ways in which it affects the economy is through its effect on consumer spending (Campbell, 1996; Starr-McCluer, 1998; Ludvigson and Steindel 1999 and Poterba 2000). The impact of stock market volatility on consumer spending is related via the wealth effect. Increased wealth will drive up consumer spending. However, a fall in stock market will weaken consumer confidence and thus drive down consumer spending. Stock market volatility may also affect business investment (Zuliu, 1995) and economic growth directly (Levine and Zervos, 1996 and Arestis et al 2001). A rise in stock market

volatility can be interpreted as a rise in risk of equity investment and thus a shift of funds to less risky assets. This move could lead to a rise in cost of funds to firms and thus new firms might bear this effect as investors will turn to purchase of stock in larger, well known firms.

While there is a general consensus on what constitutes stock market volatility and, to a lesser extent, on how to measure it, there is far less agreement on the causes of changes in stock market volatility. Some economists see the causes of volatility in the arrival of new, unanticipated information that alters expected returns on a stock (Engle and Ng, 1993). Thus, changes in market volatility would merely reflect changes in the local or global economic environment. Others claim that volatility is caused mainly by changes in trading volume, practices or patterns, which in turn are driven by factors such as modifications in macroeconomic policies, shifts in investor tolerance of risk and increased uncertainty.

The degree of stock market volatility can help forecasters predict the path of an economy's growth and the structure of volatility can imply that "investors now need to hold more stocks in their portfolio to achieve diversification" (Krainer, J, 2002:1).

This case is more serious for small developing economies like Fiji who is attempting to deepen its financial sector by developing its stock market. Unlike mature stock markets of advanced economies, the stock markets of less developed economies like Fiji began to develop rapidly only in the last two decades and are sensitive to factors such as changes in the levels of economic activities, changes in the political and international economic environment and also related to the changes in the macro economic variables. Therefore, in this paper, we examine if Fiji's Stock market is volatile and if so, then what is the role of interest rate being one of the most important macroeconomic variables on the volatility of stock returns.

This article benefits from developments in the measurement of volatility through econometric techniques. Here, the regime-switching- ARCH model introduced by Engle (1982) and its extension, the GARCH model, (Bollerslev, 1986) is used to estimate the conditional variance of Fiji's daily stock return from January 2001 to December 2005. This method allows for an objective determination of the presence of volatility. The results of estimates of stock return volatility is then related to changes in the interest rates.

The second section of the paper provides an overview of Fiji's stock market. The third section of the paper provides an exposition of the methodology used in this study. The fourth section provides a summary of the results and its discussion. The last section provides a summary and conclusion.

## **B. Stock Market in Fiji: An Overview**

Fiji's Stock Exchange, the South Pacific Stock Exchange (SPSE) which was formerly known as Suva Stock Exchange (SSE) had existed since 1979, but it initially operated only as a trading post. For the stock market the commencement of a formal call market trading from 1st July 1996 at the Suva Stock Exchange (SSE) and the establishment of the Capital Markets Development Authority (CMDA) in 1997 have added momentum to the equity market. In December 2000 Fiji's stock market name was changed from SSE to South Pacific Stock Exchange (SPSE) to allow for listing and investing opportunities in the South Pacific. The call market was introduced on 1<sup>st</sup> July 1996, initially being called 3 times in a week. The market operates through market officials verbally calling for orders on each particular security and the brokers then shout their orders. From 2003 the market has been called five times a week, i.e. Monday to Friday. The stock market has a key role to play in promoting Fiji as a financial service centre of repute<sup>1</sup>. It has become quite obvious that having a reputable domestic stock exchange is one of the major attributes that sophisticated financial services players look for when making their investment decisions, as this increases efficiency in trading (Bonnici 1997). The stock exchange provides a market for motivated buyers and sellers of shares. This improves the convenience in the trading of shares and it also encourages local investment, as the investors have confidence in

---

<sup>1</sup> While SPSE is a regional exchange but only shares in Fiji based companies are currently quoted.

putting their savings in institutions like this. The government has also assisted in the development of the market by exempting tax on dividends for listed companies and has commenced the float of shares in government owned enterprises.

The SPSE is not a highly liquid market though liquidity is improving over time. In absolute terms, the exchange has made some progress. The number of listed companies has grown from 4 in 1996 to 16 in 2005, the market capitalization increased from F\$M114 to F\$M1 023 and the volume of trade has increased from \$0.2m to \$7.8m over the same period (see Appendix 1 to 4). In order to bring more development to the stock market there are lot of challenges ahead for the stock exchange such as increasing public awareness about the operation of the SPSE, re looking at the stringency of listing rules, finding ways to encourage more listings and staff training to improve the operations of the SPSE.

### C. Methodology

The autoregressive conditional heteroskedasticity (ARCH) models introduced by Engle (1982) and its extension, the GARCH models (Bollerslev, 1986) have been the most commonly employed class of time series models in the recent finance literature for studying volatility. The appeal of the models is that it captures both volatility clustering and unconditional return distributions with heavy tails.

The estimation of GARCH model involves the joint estimation of a mean and a conditional variance equation. The GARCH (1,1) model which is stated as follows:

$$Y_t = x_t' \theta + \varepsilon_t$$

Where the above is the conditional mean equation with  $x_t$  being the vector of exogenous variables. The conditional variance,  $\sigma_t^2$ , can be stated as follows:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

where  $\omega$  is a constant term,  $\alpha \varepsilon_{t-1}^2$  is the ARCH term and  $\beta \sigma_{t-1}^2$  is the GARCH term.

The SPSE being the only source in Fiji is the data source for the stock market return. The daily stock market return data has been collected on the time series basis for the period between 2001-2005. For the interest rate information, the Reserve Bank of Fiji was the source.

### D. Results and Discussion

The Stock Market of Fiji consists of 16 firms. These are Atlantic Pacific Packaging Company Limited (APP), Amalgamated Telecom Holdings Limited (ATH), South Seas Company Limited (BPT), Carlton Brewery Fiji Limited (CBF), Communications Fiji Limited (CFL), Fijian Holdings Limited (FHL), Fiji Care Insurance Limited (FCI), Flour Mills of Fiji Limited (FMF), Fiji Sugar Corporation Limited (FSC), Fiji Television Limited (FTV), Kontiki Growth Fund (KGF), Pacific Green Fiji Limited (PGI), R.B. Group Limited (RBG), Rice Company of Fiji Limited (RCF), South Pacific Distilleries Limited (SPD), Toyota Tsusho Limited (TTS) and Vishal Bharteeya Company Limited (VBL).

The LM test statistic analysis presented in Table 2 below shows that there is a strong evidence of conditional heteroscedasticity for seven stock prices. These are: Amalgamated Telecom Holdings Limited (ATH), Fijian Holdings Limited (FHL), Flour Mills of Fiji Limited (FMF), Fiji Television Limited (FTV), Pacific Green Fiji Limited (PGI), R.B. Group Limited (RBG), and Vishal Bharteeya Company Limited (VBL).

**Table 1:** LM Test for Conditional Heteroskedasticity

Firm	F-Statistic	P-value	Obs R Squared	P-value
Atlantic Pacific Packaging Company Limited	0.0311	0.999	0.318	0.999
Amalgamated Telecom Holdings Limited	8.405	0.000	72.853	0.000*
Carlton Brewery Fiji Limited	0.039	0.999	0.400	0.999
Communications Fiji Limited	0.141	0.999	1.447	0.999
Fiji Care Insurance Limited	0.015	1.000	0.159	1.000
Fijian Holdings Limited	4.644	0.000	43.344	0.000*
Flour Mills of Fiji Limited	5.396	0.000	49.65	0.000*
Fiji Sugar Corporation Limited	0.018	1.000	0.194	1.000
Fiji Television Limited	16.076	0.000	123.479	0.000*
Pacific Green Fiji Limited	7.314	0.000	64.999	0.000*
R.B. Group Limited	10.475	0.000	88.095	0.000*
Rice Company of Fiji Limited	0.0885	0.999	0.9036	0.999
South Pacific Distilleries Limited	0.004	1.000	0.0437	1.000
Toyota Tsusho Limited	0.037	0.999	0.3797	0.999
Vishal Bharteeya Company Limited	14.709	0.000	115.42	0.000*

Furthermore, from the variance equation, it can be seen that for those stock prices which had conditional heteroscedasticity, the GARCH coefficients are statistically significant as their individual p-values are 0.

**Table 2:** Variance Equation Estimates of Each Firms Stock Markets Return.

Firm	Coefficients		
	C	Residual (-1) <sup>2</sup>	Garch (-1)
Atlantic Pacific Packaging Company Limited	5.15 E-05 -0.004	-0.0065 (0.000)	0.829 (0.000) *
Amalgamated Telecom Holdings Limited	1.01 E -05(0.000)	0.249(0.000)	0.274(0.000) *
Carlton Brewery Fiji Limited	6.55 E-05 -0.174	-0.007 (0.000)	0.607 -0.0367
Communications Fiji Limited	5.73 E-05 -0.055	-0.016 (0.000)	0.676 (0.000) *
Fiji Care Insurance Limited	5.35 E -05 -0.358	-0.007 (0.000)	0.563 -0.236
Fijian Holdings Limited	4.14 E-07 (0.000)	0.125 (0.000)	0.833 (0.000) *
Flour Mills of Fiji Limited	2.85 E-05(0.001)	0.027 (0.000)	0.818 (0.000) *
Flour Mills of Fiji Limited	0.001 -0.076	-0.007 (0.000)	0.588 -0.011
Fiji Television Limited	3.91 E-06 (0.000)	0.223 (0.000)	0.839 (0.000) *
Pacific Green Fiji Limited	1.69 E-05 (0.000)	0.152 (0.000)	0.567 (0.000) *
R.B. Group Limited	8.53 E -05 (0.000)	0.146 (0.000)	0.324 -0.003
Rice Company of Fiji Limited	9.31 E-06(0.000)	-0.009 (0.000)	0.867 (0.000) *
South Pacific Distilleries Limited	0.000 -0.374	-0.004 (0.000)	0.579 -0.221
Toyota Tsusho Limited	0.000 (0.000)	0.086 -0.002	-0.051 -0.009
Vishal Bharteeya Company Limited	8.82 E- 05 (0.000)	0.102 -0.054	0.757 (-0.000) *

The GARCH (1,1) models of composite index of stock market return are given below. In this model, both the ARCH and GARCH terms are insignificant.

$$\sigma_t^2 = 0.0002 + 0.9237 \varepsilon_{t-1}^2 - 0.0004 \sigma_{t-1}^2$$

(0.00006) (0.4047) (0.1274)

However, when regressed with interest rate, the ARCH terms and interest variable is significant thus indicating the role of interest rate on the volatility of stock returns. The GARCH (1,1) model with the interest variable is as follows:

$$\sigma_t^2 = 0.1221 + 1.1332 \varepsilon_{t-1}^2 + 0.0016 \sigma_{t-1}^2 - 0.0170 \text{ Interest Rate}$$

(0.0452) (0.4308) (0.0361) (0.0063)

The above results reveal that interest changes have a significant effect on stock market volatility.

## E. Summary and Conclusion

Understanding stock market risk and return behaviour is important for all countries but it is of more importance to developing countries especially where the market consist of risk –averse investors as the opportunities to invest and diversify the investment is not much. The degree of volatility presence in the stock market would lead investors to demand a higher risk premium, creating higher cost of capital, which impedes investment and slows economic development.

This study shows the level of volatility (risk) presence in Fiji’s stock market, which is still in the emerging phase. It characterizes the risk and return behaviour of the listed firms on the SPSE. The test for the presence of the volatility was carried for each specific firms listed on the stock market but the results from Table 1 reveals that of the 16 listed companies on the stock market only seven firms are volatile. These firms are: Amalgamated Telecom Holdings Limited (ATH), Fijian Holdings Limited (FHL), Flour Mills of Fiji Limited (FMF), Fiji Television Limited (FTV), Pacific Green Fiji Limited (PGI), R.B. Group Limited (RBG), and Vishal Bharteeya Company Limited (VBL).

The robustness of this analysis is that it has allowed to test for the presence of volatility for specific firms and if the analysis was done on aggregate data, then it would been of less value and probably misleading. The firms, which have appeared to be volatile, are the ones, which are sensitive to government regulations, where the liquidity has been low over the years and where the IPOs have been quite underpriced. For example, in the case of Amalgamated Telecom Holdings (ATH) the volatility could be due to the effect of the Commerce Commission’s Telecom charges announcements or due to the decline in profits caused by the corporate restructure. During the year 2005 Telecom Fiji limited, a subsidiary company of Amalgamated Telecom Holdings announced the Commerce Commission’s decision of regulating the call charges downwards for all of the ATH’s subsidiaries. Following this announcement, Amalgamated Telecom Holdings released a market announcement regarding its adverse impact on the company’s profitability.

Evidence of low liquidity has emerged for firms such as Pacific Green Fiji Limited (PGI), R.B. Group Limited (RBG), and Vishal Bharteeya Company Limited (VBL) over the years. There has been quite a low level of trading taking place for these firms and this reduced liquidity have probably contributed to the stock market return volatility for these firms in Fiji. The presence of volatility in other firms like FlourMills of Fiji Limited (FMF), Fiji Television Limited (FTV) has been due to their IPO being underpriced.

Moreover, when the stock returns were regressed with the interest rate, the ARCH term and interest variable is significant thus indicating the role of interest rate on the volatility of stock returns. Interest rates in emerging economies have grown over the past decade (Bilson, et al.) and this is no exception to the case of Fiji Islands. Over the period of the study there has been an increase in the interest rates and this has impacted on the stock return volatility.

The extant literature suggests that a wide range of factors may be relevant in explaining the stock return volatility. Such variables include goods prices, money supply, real activity, exchange rates, political risks, oil prices, trade sector, and regional stock market indices. However, in emerging

markets not all factors are at play in explaining the stock return volatility but factors like levels of political risks, goods prices, money supply and exchange rates may be analysed to see the empirical links with the stock returns volatility. to find the effects of these on Fijis stock volatility further research is required.

The findings of this research do have some implications for the investors in Fiji as volatility in the stock return of a firm stems from the fact that stock returns may no longer be seen as the true intrinsic value of a firm and thus the investors might start losing confidence in the stock market.

## References

- [1] Arestis, P., P.O. Demetriades and K.B. Luintel (2001) "Financial Development and Economic Growth: The Role of Stock Markets", *Journal of Money, Credit and Banking*, 33(2):16-41.
- [2] Bilson, C.M., Brailsford, T.J. and Hooper, V.J. (1999) "Selecting Macroeconomic Variables as Explanatory Factors of Emerging Stock Market Returns". *Working Paper*.
- [3] Bollerslev, T (1986) Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31(1):307-327.
- [4] Bonnici, M., (1997), 'Letter of Transmittal' Minister of Finance & Commerce, Malta.
- [5] Campbell, J (1996) Consumption and the Stock Market: Interpreting International Experience", *NBER Working Paper*, 5610.
- [6] Capital Markets Development Authority. Published Annual Reports.
- [7] Engle, R. F (1982) Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of the U.K. Inflation, *Econometrica*, 50(3):987-1008.
- [8] Krainer, J (2002) "Stock Market Volatility", FRBSF Economic Letter, *Western Banking*, 2002-32, pp1-4.
- [9] Levine, R and S. Zervos (1996) "Stock Market Development and Long-Run Growth", *World Bank Economic Review*, 10(1):323-339.
- [10] Ludvigson, S and C. Steindel (1999) "How Important is the Stock Market Effect on Consumption" *Federal Reserve Bank of New York Economic Policy Review*, 5(1):29-51.
- [11] Poterba, J. M (2000) "Stock Market Wealth and Consumption", *Journal of Economic Perspectives*, 14(2):99-118.
- [12] Starr-McCluer, M (1998) "Stock Market Wealth and Consumer Spending", Board of Governors of the Federal Reserve System, *Finance and Economics Discussion Paper Series*, 98/20.
- [13] South Pacific Stock Exchange. Published Annual Reports.
- [14] Zulu, H (1995) "Stock market Volatility and Corporate Investment", *IMF Working Paper*, 95/102.

## Appendices

### Appendix 1: Volume and Value of Shares Traded, 1996 to 2005

Year	Volume of shares traded (million)	Value of shares traded (\$million)
1996	0.2	0.4
1997	2.1	2.9
1998	4.6*	9.7
1999	3.4	4.9
2000	2.5	8.1
2001	2.6	4.4
2002	6.8	7.1
2003	3.6	4.3
2004	7.8	12.7
2005	5.9	7.9

Data Source: South Pacific Stock Exchange.

\* Includes the takeover of 1.6 million SPD shares by CBF and the transfer of 1.4m Fiji TV shares through a private transaction. The general trend is one of fluctuations between 1996 and 2005. However, the volume and value of shares traded in 2005 is higher than 1996.

### Appendix 2: Market Capitalization, 1996-2005

YEAR	No. of Listed Companies	Market Capitalization (\$million)
1996	4	114
1997	8	144
1998	9	175
1999	9	214
2000	10	243
2001	14	275
2002	15	769
2003	15	748
2004	16	882
2005	16	1 024

Data Source: South Pacific Stock Exchange.

### Appendix 3: Market Liquidity (Total value traded/GDP)

Year	Value of Shares Traded (million \$)	Gross Domestic Product (GDP) (\$ million)	Total value traded/ GDP (percentage)
1996	0.4	2575	0.0002
1997	2.8	2571.1	0.001
1998	9.6	2792.5	0.003
1999	4.9	3238.8	0.002
2000	8.1	3049.1	0.003
2001	4.4	3199.5	0.001
2002	7.1	3442.9	0.002
2003	4.3	3546.2 (estimate)	0.001
2004	12.7	3584.1 (estimate)	0.004

Data Source: South Pacific Stock Exchange.

**Appendix 4: Market Liquidity (Turnover Ratio)**

<b>Year</b>	<b>Value of Shares Traded (million \$)</b>	<b>Market Capitalization (\$million)</b>	<b>Turnover Ratio (%)</b>
1996	0.4	114	0.4
1997	2.8	144	1.9
1998	9.6	175	5.5
1999	4.9	214	2.3
2000	8.1	243	3.3
2001	4.4	275	1.6
2002	7.1	769	0.9
2003	4.3	748	0.6
2004	12.7	882	1.4
2005	7.9	1 024	0.8

Data Source: South Pacific Stock Exchange.