# Empirical Investigation of Price Variability Mechanism of the Colombo All Share Price Index

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**Abstract**

There is considerable quantitative research on stock market volatility internationally, but little on SriLanka's emerging stock markets. Using Colombo Stock Exchange ASPI return data, this paper investigates the index price variability mechanism in different time horizons using Realized volatility as a tool. The paper also considers S&P CNX Nifty Index of National Stock Exchange, India for computing the Index returns variability during 2005-2009 and then investigates whether any analogous asymmetric characteristic is reflected in the two emerging markets. We find no significant asymmetry in the volatility proportions computed in different time horizon on either of the considered emerging markets as compared to a common finding for developed stock markets that exhibits a larger return volatility due to negative shock entering the market.

**Keywords***:* ASPI, NIFTY, Realized Volatility

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## 1. Introduction

Volatility permeates finance. The variation in economy-wide risk factors is important for the pricing of financial securities, and return volatility is a key input to option pricing and portfolio allocation problems. As such, accurate measures and good forecasts of volatility are critical for the implementation and evaluation of asset and derivative pricing theories as well as trading and hedging strategies. It is also a well-established fact, dating back to Mandelbrot (1963) and Fama (1965), that financial returns display pronounced volatility clustering. However, only over the last decade have financial economists begun to seriously model these temporal dependencies.

Today, the gathering of empirical evidence makes us recognize that the conditional variance is both time-varying and highly persistent. Such stylized facts were uncovered by the development and application of strict parametric models, such as ARCH (see, e.g., Bollerslev, Engle & Nelson, 1994), through stochastic volatility models (e.g., Ghysels, Harvey & Renault, 1996), and more recently non-parametric methods based on high-frequency data, the most conspicuous idea being *realized variance* (*RV*) (see, e.g., Andersen, Bollerslev, Diebold & Labys, 2001).

*RV* is the sum of squared returns over non-overlapping intervals within a sampling period. The theory states that, given weak regularity conditions, *RV* converges in probability to the *quadratic variation* (*QV* ) of all semimartingales as the sampling frequency tends to infinity (e.g., Protter (2004)).

Bollerslev *et al.* (1982) cited a phenomenal number of papers which have applied ARCH, GARCH and other related models. More recent research, following Black's observation in 1976, concentrates on the finding that the effect of good and bad news on

return volatility is asymmetric rater than symmetric. A common finding for developed stock market (see, e.g. Christie, 1982; French *et. al.* 1987; Nelson, 1991; Schwert, 1990) is that negative shocks to the market lead to larger return volatility than positive shocks of a similar magnitude. However, to study the existence of any such asymmetry among the emerging markets, two Asian emerging stock markets of similar starting dates are investigated, namely the Colombo Stock Exchange (CSE), Sri Lanka and the National Stock Exchange (NSE) of India.

The Colombo Stock Exchange (CSE) is the main stock exchange in Sri Lanka that became the first South Asian member of the World Federation of Stock Exchanges in 1998 and it is also a founding member of the South Asian Federation of Exchanges (SAFE). As of 31st September 2009, the exchange has 432 listed companies, and 20 business sectors are represented. It has a market capitalization of over 1,008 billion rupees (over US $ 9.9 billion) and this corresponds to approximately 25% of the country's GDP. Two indices currently exist in the CSE - The All Share Price Index (ASPI) and The Milanka Price Index (MPI). The CSE has proven itself to be one of the top Emerging Markets stock exchange in the world, with a recorded consistent annual growth of over 30% in 2002-2004, and in 2006, an annual growth of 41.6% was attained. It continued to achieve strong growth in 2007, which saw the stock exchange achieve a historic milestone - ASPI surpassed the 3000 mark for the first time in history. The excellent performance of CSE has been attributed to its advanced infrastructure of a fully automated trading platform, therefore enhancing its competitive edge and efficiency among the modern exchanges today. Indices gained more than 120% for the 2009.

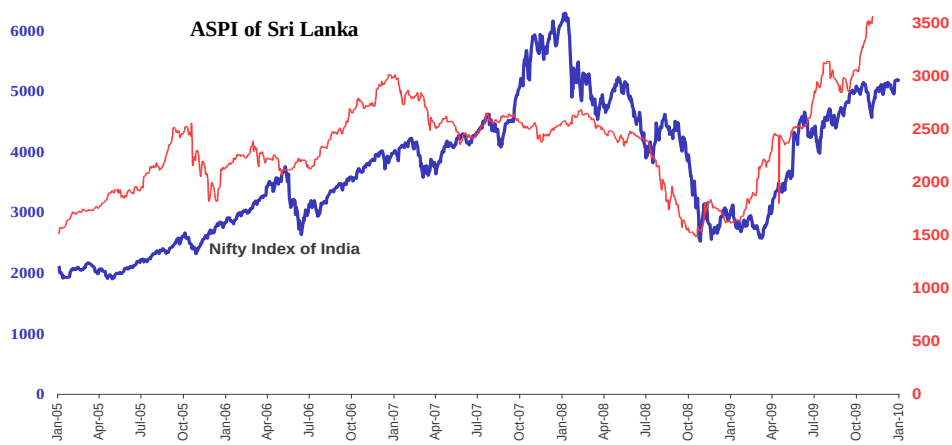
Since May 2009 Colombo Stock Market has been experiencing continuous upward trend, since Sri Lankan Government officially announced that LTTE terrorist was completely defeated on 19th May 2009. Now business communities are optimistic that Sri Lanka can go to a new level of development from now onward even with unfavorable economic conditions in other parts of the world. Realizing the potential of Colombo market, it is expected to attract more foreign investors that can set new records in near future.

The Standard & Poor's (S&P) CNX Nifty is owned and managed by India Index Services and Products IISL, a joint venture between National Stock Exchange (NSE) which is the 3rd largest stock exchange in the world in terms of number of transactions in stock futures and the Credit Rating Information Services of India Limited (CRISIL), India's leading credit rating agency. It comprises of India's 50 top companies representing 24 different sectors of the Indian economy and is used for a variety of purposes such as benchmarking fund portfolios, index based derivatives and index funds. It represented approximately 65% (as on September 2009) of the total market capitalization of India. For anyone interested in India, Deutsche has launched XNIF - the first internationally traded Exchange Traded Funds linked to the S&P CNX Nifty, which provides investors in Europe a convenient and efficient way to gain exposure to one of the world's fastest growing economies. Further, relative to the markets in the west, the Asian markets are almost certain to experience fabulous investments over the long term. Given the near consensus on decoupling, the obvious place for the next bubble to form will be in Asian and emerging market asset prices and the related commodity markets. Thus, a sustained research effort in markets like India and Sri Lanka is of considerable

interest and value. The association between trends in these markets during the past five years 2005-2009 is quite apparent from the graphical exposition on Historical price

**Historical Price Movement of ASPI & NIFTY Index**

movement of ASPI and NIFTY.




## 2. Data and Methodology

### A. The Data and Calculation of Returns

The study focuses on the Index price return variability of ASPI and CNX Nifty during year 2005 to 2009. For each of the Index daily open and closing prices from January 1, 2005 to December 31, 2009 are investigated. The data was obtained from Yahoofinance.com. Inter-daily returns are identified as the difference in the natural logarithm of the closing and open index value for a trading day.

$$R_t = \ln(P_{t,closing} / P_{t,open})$$

where:

$R_t$ = the $t$ time holding period returns

$P_{t,\ closing}$ = the closing index price during the $t$ time holding period

$P_{t,\ open}$ = the open index price during the $t$ time holding period

For computing Weekly, Monthly and Quarterly returns, the difference in the natural logarithms of the closing and open Index value of the respective trading periods are considered.

**B. Return Volatility**

*Realized Volatility*, also called *historical Volatility*, is the standard deviation of a set of previous returns. For *n* trading periods, and return $r_{t-n},..., r_{t-1}$, whose average is $\bar{r}$, the historical standard deviation $\sigma_t = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(r_{t-i} - \bar{r})^2}$ provides a simple estimate of the standard deviation of the return for the trading period *t*.

Inter-weekday, month and quarterly volatility patterns can be modeled by multiplicative factors, which may vary across the days of the week, months and quarters of the year. Volatility factors $\lambda_j$ are defined by supposing

$$\mathrm{var}(r_{t,j} \mid \sigma_t) = \lambda_j \sigma_t^2 \quad \text{with} \sum_{j=1}^{N} \lambda_j = 1$$

Thus $\lambda_j$ is the proportion of the trading period's return variance that is attributed to period *j*. Following Taylor and Xu (1997), Simple estimates of the variance proportions, when expected returns can be assumed to be zero, are given by

$$\hat{\lambda}_j = \frac{\sum_t r_{t,j}^2}{\sum_t \sum_{k=1}^{N} r_{t,k}^2}$$

## 3. Index Price Return Distribution of ASPI and CNX NIFTY

**A. Empirical properties of Index price returns**

Table I documents the average characteristics of Inter-period returns. It can be observed that ASPI observed higher average returns with less variation than the NIFTY

during a day and week of 2009. Average daily returns of .09% observed in 2005 are now .33% during 2009, increased by more than a triplet in five years. 52% fall in ASPI during 2008 made a fabulous recovery showing nearly 81.2% growths during 2009. ASPI has observed a fall of maximum to 8% in a day, while NIFTY was more influenced by financial turmoil and was down by 13% in a single day during 2008. Maximum daily returns of around 16% in a day were also observed in NIFTY. Interestingly, average Index growth during the last five years has shown a similar trend with 16.19% in ASPI and 18.31% in NIFTY. Further, t-test of means suggest no significant evidence of differences in growth of both indices computed in different time horizons.

Under the assumption of normality, skewness and kurtosis have asymptotic distribution N(0, 6/T) and N(3,24/T), respectively, where T is the number of return observations. The return distribution is negatively skewed for ASPI and NIFTY, indicating that the distribution is non-symmetric. Furthermore, Comparing the data with the normal distribution, returns have relatively large value of kurtosis > 3 in almost every different time horizons suggesting that the underlying data are leptokurtic, or fat-tailed and sharply peaked about the mean.

Table I: The Characteristics of Index Price Returns of ASPI and NIFTY in different time horizons

| **Time Horizon** | **Mean** | | **Std. Deviation** | | **Minimum** | | **Maximum** | | **Skewness** | | **Kurtosis** | | **JB Test (p-value)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Daily*** | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* | *ASPI* | *NIFTY* |
| 2005 | 0.09% | 0.11% | 1.38% | 1.08% | -7.53% | -3.62% | 4.67% | 3.16% | -2.12 | -0.51 | 11.65 | 0.79 | 0.00 | 0.00 |
| 2006 | 0.15% | 0.10% | 1.09% | 1.56% | -4.22% | -7.05% | 7.30% | 5.19% | 0.59 | -0.86 | 9.83 | 3.19 | 0.00 | 0.00 |
| 2007 | -0.04% | 0.17% | 0.78% | 1.60% | -2.96% | -5.04% | 3.06% | 5.41% | -0.11 | -0.22 | 2.23 | 1.54 | 0.04 | 0.00 |
| 2008 | -0.23% | -0.30% | 1.14% | 2.78% | -5.06% | -12.78% | 3.42% | 6.79% | -0.54 | -0.26 | 3.35 | 1.68 | 0.00 | 0.00 |
| 2009 | 0.33% | 0.22% | 1.30% | 2.14% | -5.11% | -6.38% | 6.26% | 16.29% | 0.78 | 1.55 | 4.26 | 12.89 | 0.00 | 0.00 |
| 2005-09 | 0.06% | 0.06% | 1.17% | 1.92% | -7.53% | -12.78% | 7.30% | 16.29% | -0.41 | -0.02 | 8.32 | 7.06 | 0.00 | 0.00 |
| ***Weekly*** | | | | | | | | | | | | | | |
| 2005 | 6.09% | 0.51% | 20.98% | 2.71% | -23.62% | -5.39% | 24.90% | 5.21% | -1.36 | -0.32 | 2.16 | -0.59 | 0.00 | 0.00 |
| 2006 | 8.70% | 0.18% | 10.53% | 3.05% | -6.85% | -11.73% | 16.38% | 6.68% | -1.81 | -1.35 | 3.45 | 4.30 | 0.00 | 0.00 |
| 2007 | -1.72% | 0.66% | 4.50% | 3.42% | -8.12% | -5.54% | 2.45% | 9.17% | -1.36 | 0.08 | 2.57 | -0.18 | 0.00 | 0.00 |
| 2008 | -13.13% | -1.20% | 16.01% | 5.45% | -35.44% | -18.47% | 0.37% | 11.05% | -1.27 | -0.85 | 1.15 | 1.77 | 0.00 | 0.01 |
| 2009 | 20.30% | 0.87% | 13.49% | 3.88% | 8.60% | -7.46% | 39.53% | 14.32% | 1.43 | 0.44 | 2.27 | 1.95 | 0.00 | 0.16 |
| 2005-09 | 4.05% | 0.21% | 17.02% | 3.86% | -35.44% | -18.47% | 39.53% | 14.32% | -0.35 | -0.76 | 0.80 | 3.47 | 0.00 | 0.00 |
| ***Monthly*** | | | | | | | | | | | | | | |
| 2005 | 2.03% | 2.58% | 8.29% | 6.50% | -17.61% | -9.26% | 12.66% | 11.21% | -1.40 | -0.57 | 2.06 | -0.67 | 0.11 | 0.02 |
| 2006 | 2.90% | 3.13% | 5.21% | 5.03% | -4.14% | -9.65% | 12.38% | 10.14% | 0.59 | -1.35 | -0.49 | 3.44 | 0.03 | 0.15 |
| 2007 | -0.57% | 3.63% | 5.07% | 6.51% | -11.40% | -8.63% | 7.15% | 16.13% | -0.84 | 0.12 | 0.64 | 0.65 | 0.12 | 0.25 |
| 2008 | -4.38% | -6.23% | 6.20% | 12.09% | -16.22% | -30.68% | 3.41% | 8.70% | -0.56 | -0.58 | -0.57 | -0.21 | 0.03 | 0.05 |
| 2009 | 6.77% | 4.65% | 8.79% | 9.05% | -7.23% | -7.67% | 19.20% | 24.60% | -0.05 | 0.78 | -1.23 | 0.74 | 0.01 | 0.15 |
| 2005-09 | 1.35% | 1.55% | 7.63% | 8.88% | -17.61% | -30.68% | 19.20% | 24.60% | -0.06 | -0.89 | 0.39 | 2.53 | 0.00 | 0.02 |
| ***Quarterly*** | | | | | | | | | | | | | | |
| 2005 | 0.47% | 7.76% | 3.12% | 7.42% | -11.45% | -2.16% | 5.58% | 15.83% | -1.40 | -0.73 | 3.59 | 1.80 | 0.00 | 0.03 |
| 2006 | 0.92% | 8.37% | 2.37% | 11.68% | -4.18% | -8.42% | 9.65% | 18.18% | 1.04 | -1.52 | 3.12 | 2.53 | 0.01 | 0.00 |
| 2007 | -0.33% | 10.92% | 2.03% | 10.28% | -4.76% | -3.72% | 4.76% | 20.09% | 0.00 | -1.40 | 0.12 | 2.37 | 0.00 | 0.00 |
| 2008 | -0.99% | -18.24% | 3.11% | 11.49% | -11.33% | -28.17% | 4.71% | -2.98% | -1.04 | 0.94 | 2.44 | -0.61 | 0.01 | 0.00 |
| 2009 | 1.74% | 14.02% | 3.68% | 15.65% | -4.86% | 1.93% | 11.81% | 35.00% | 0.39 | 1.02 | 0.06 | -0.44 | 0.00 | 0.00 |
| 2005-09 | 0.36% | 4.56% | 3.04% | 15.76% | -11.45% | -28.17% | 11.81% | 35.00% | -0.14 | -0.52 | 2.45 | 0.25 | 0.15 | 0.00 |
| *Yearly* | | | | | | | | | | | | | | |
| 2005-2009 | 16.19% | 18.31% | 49.73% | 51.97% | -52.51% | -72.94% | 81.20% | 56.26% | -0.19 | -2.03 | 0.29 | 4.32 | 0.46 | 0.15 |

*T test: paired for two sample of mean returns*: P(T≤ t) two tail: 0.957 (daily), 0.413 (weekly), 0.835 (Monthly), 0.389 (Quarterly)

**B. Realized Volatility estimates of Index returns**

Table II reports the computation of realized volatility and realized variance alongwith variance proportions discussed in section II of the paper. From the results-no significant asymmetry in the volatility of returns of the two emerging equity markets considered in the study was found. In comparison to ASPI, NIFTY has observed little higher volatility in Index returns computed in different time horizons. Intra-week volatility proportion contributing to a week volatility returns were found to be maximum on Monday for both the indices due to the open of the trading day after a two days week holidays. ASPI observes similar volatility proportions throughout week, while Nifty having highest on Monday and least volatile on the fourth day of the week.

For monthly returns of ASPI, week signals of volatility were observed in February, March, April, June, July and October. Likewise, the results of Nifty indicate that month of May and October contributes to the higher volatility factors. When time horizon is Quarterly, then CSE, Sri Lanka and NSE of India both observed the lowest volatility proportions in Quarter I.

Conducting Jarque-Bera test for finding the existence of asymmetry in volatility factors of return, among the weekdays $p$ value (=0.0137) is insignificant at 1% level implying no significant asymmetry exists in the volatility proportions of ASPI during the week. Similar results for volatility proportions during the weekdays were obtained for Indian Stock Market's NIFTY Index (p-value 0.3248). Volatility factors during different quarters were also found to have insignificant asymmetry in both the exchanges of India and Sri Lanka considered for the study. However, there was some evidences of

asymmetry in the volatility factors of return when measured among the months of the year for Colombo Stock Exchange ($p$ = 0.0039).

Table II: Realized Volatility estimates of ASPI and NIFTY

| | *All Share Price Index, CSE* | | *S&P CNX NIFTY, NSE* | |
|---|---|---|---|---|
| **Time Horizon** | **Realized Volatility** '$\sigma_t$' | **Realized Variance** $\mathrm{var}(r_t) = \sigma_t^2$ | **Realized Volatility** '$\sigma_t$' | **Realized Variance** $\mathrm{var}(r_t) = \sigma_t^2$ |
| *Daily* | 0.011673 | 0.000136 | 0.019082 | 0.000364 |
| *Weekly* | 0.030428 | 0.000926 | 0.038562 | 0.000015 |
| | **Variance Proportions** '$\lambda_j$' | | **Variance Proportions** '$\lambda_j$' | |
| Monday | | 0.222502 | | 0.296049 |
| Tuesday | | 0.220546 | | 0.155852 |
| Wednesday | | 0.165276 | | 0.173662 |
| Thursday | | 0.223984 | | 0.154473 |
| Friday | | 0.167693 | | 0.219964 |
| *Monthly* | 0.076305 | 0.005823 | 0.088811 | 0.007887 |
| | **Variance Proportions** '$\lambda_j$' | | **Variance Proportions** '$\lambda_j$' | |
| January | | 0.178232 | | 0.076637 |
| February | | 0.026523 | | 0.021436 |
| March | | 0.018770 | | 0.061165 |
| April | | 0.045923 | | 0.077131 |
| May | | 0.149968 | | 0.181879 |
| June | | 0.035140 | | 0.084273 |
| July | | 0.031890 | | 0.030925 |
| August | | 0.013723 | | 0.018580 |
| September | | 0.142760 | | 0.088515 |
| October | | 0.081652 | | 0.281660 |
| November | | 0.101481 | | 0.047294 |
| December | | 0.173938 | | 0.030504 |
| *Quarterly* | 0.170185 | 0.028963 | 0.157618 | 0.024843 |
| | **Variance Proportions** '$\lambda_j$' | | **Variance Proportions** '$\lambda_j$' | |
| Quarter I | | 0.098694 | | 0.199705 |
| Quarter II | | 0.300645 | | 0.345117 |
| Quarter III | | 0.224796 | | 0.187139 |
| Quarter IV | | 0.375865 | | 0.268040 |
| *Yearly* | 0.497292 | 0.247300 | 0.519681 | 0.270068 |

## 4. Summary and Conclusions

The aim of this paper was to investigate whether the common finding regarding the asymmetric impact of news on the volatility of returns also applied to the emerging markets. For the ASPI index-no significant asymmetry in the volatility factors of index returns in different time horizons was found. Likewise, the results of J-B test for the NIFTY are also confirmed for the volatility proportions computed among the weekdays, and the different quarters of the year.

A possible reason for the finding is that the dissemination of information to investors is slow and therefore, when investors finally receive the information, some consider it too late to respond, or investors do respond but with a time lag. It is arguable that the investors of such countries relative to those of developed countries are more "immune" to the same degree of "good" or "bad" news entering the exchange. Thus, their reactions may be relatively more dampened.

Further, interesting research would be to examine whether these results hold for a different sample size and for when each of the markets is more developed. A number of complementary explanations related to investor behavior and psychology, the nature of financing of firms on the stock exchange, the volume of trade and the institutional structure of the exchange can be proposed.

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