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Extreme Volatility and Market Testing of Efficiency on Small Cap Indices

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Abstract

We examined the volatility and market efficiency countries small cap indices and also tested the relationship exists between emerging and developed countries small cap indices. The data consisted of daily series of International market Small-Cap indices which are from MSCI (Morgan Stanley Capital International) are used for analysis. The market index series were measured in dollar currency terms and no major discrepancies were found in the data. The study period is from 2009 to 2015 and the historical data used leading emerging countries such as Brazil, China, India, Indonesia, Korea, Malaysia, Philippines, Russia, South Africa and Taiwan and leading industrialized countries such as Australia, Belgium, Finland, France, Germany, Italy, Netherland, Norway, Switzerland and United Kingdom. We found that the industrialized countries have the market efficiency, it means the present price does not influence by the past price, whereas the emerging countries does not have the same. The volatility most of the countries have the reasonably long persistence of volatility.

Keywords: *International small cap indices, market efficiency, volatility, MSCI, market testing.*

1. INTRODUCTION

The small companies, which are engaged in the stock market, also indicate the economy. Like all indices they yield return to the investors, and the returns are volatile in nature. Irrespective of the location in the Small-Cap companies the investment used to be small depending on the source of the entrepreneur and the requirement of capital needed for production. All industries do not require large capital base, mainly infrastructure industries need heavy capital base, but firms that manufacture spare parts are require only limited capital.

Several studies have been undertaken to analyse the capital market some of them are reviewed in this section:

Mohanty (2001) had analysed the efficiency of the small stocks in the market. The sample period was 1991-99, the return differential between small and large stocks was in the excess of 70% on an annualised basis, using Fama and French (1993,1995,and 1996) multifactor model, found that size indeed is a proxy for risk. However, the return earned by the small companies was too large given their risk exposure. The transaction cost explained a large part of this return difference. Using Rolls (1984) method, found that the bid -ask spread difference for the smaller stock was about 3%. It was less than 1% for the large stocks. Using data on 100 companies, found that transaction costs completely erased the return differential.

Cheol S.Eun and Wei Huang (2003) have analysed the pricing of the world covariance risk of large cap stocks and Small-Cap stocks. The sample period was 20 years (1980-99) on nine developed countries indices. According to them three major findings were observed, large cap stock indices across the countries were co integrated, whereas Small-Cap stock indices were not, the price of world covariance risk was not significantly different across countries for mid and Small-Cap portfolios, the financial integration

in the 1990 had deepened for large cap stock portfolios in all sample countries. The same happened for Mid Cap and small portfolios on in some countries.

David M.Blitzer and Srikant Dash (1996) have studied the active management work for Small-Cap stocks. According to them measurement techniques and benchmark selections significantly affect any evaluation of active management performance in Small-Caps. Correcting for survivorship bias, using asset weighted fund returns and substituting the Standard and Poor (S&P) Small-Cap 600 the Russell 2000 as a bench mark pointed a far less rosy picture of active management in Small-Cap than commonly believed.

Sunil Jain (2007) had studied the mid and Small-Cap stocks in the rally. According to his study, many Mid Cap and Small-Cap companies had out performed large cap stocks in terms of sales ad profit growth. The growth in aggregate sales and profit of the companies from BSE Mid Cap and Small-Cap index, which had declared their results, reported 32 per cent and 68 per cent respectively. Hence, besides the continues good performance, strong results were delivered by Small-Cap companies.

Christopher Graja and Elizabeth Ungar (1999) have analysed the investing in Small-Cap stocks, for a sample period of 5 years. According to his view, Small-Cap had become one of the hottest asset classes with consultants and pension plans over the past two years. Ever since the ground breaking works of Banz and Reinaganuam, Small-Cap stocks were treated as a different asset class. He studied at different Small-Capatilisation style managers relative to core manager.

John Spence (2002) had studied Small-Cap indices of Russell 2000 and S&P 600. The sample period was 1992 to 2000. This study examined the performance gap between the S&P 600 and Russell 2000. The S&P 600 increased by 3.1 per cent on an average since, 1992. The S&P 600 had consistently outperformed in the post bubble environment. An examination of the bench marks in terms of their makeup, reconstitution methodologies, sector weights and several other factors explain that there was reason to believe the Russell 2000 performance distortions.

Micheal. M (1992) has studied Small-Cap companies' performances. A study by Oppenheimer Capitals revealed that Small-Cap stocks had out performed the S&P 500 by a wide margin since 1925. For each $ I invested, the S P 500 returned total of $517 by December 1990, compounded rate of return of 10% The same 1 $ invested in the smaller issues 1925, produced a compound rate of return of 12%. The extra two percentage points mean that 1$ investments grew to $ 1,277 versus the $ 517 yielded by the S P 500.

Chandra Babu and Punithavathy Pandian (2002) analyzed the weak form efficiency of the Indian stock market. They used daily and weekly closing stock price of 40 companies from different industries and six leading indices namely the BSE 200, the BSE Sensex the S P CN X 500, the CNX Nifty the S P CNX Nifty and the CNX Nifty Junior from 1995 to January 2001. They applied autocorrelation test run test and concluded that Indian stock market had weak form of market efficiency.

Pradhan H.K. and Lakshmi S.Narashi (2002) investigated the behavior of Indian stock price indices for a sample period was 1990 to 2001 (12 years). The study was conducted on three Indian stock market indices (BSE - 30, BSE 100 and S P CNX Nifty) various tests of markets efficiency suggested that the Indian stock market was growing informationally efficient and efficiency had increased over the time. The volatility of the returns was found to increase over the period under study and this could be partly attributed to the impact of foreign portfolio flows. Negative news had more impact on the variance of the returns. Granger causality tests suggested that domestic returns affected foreign portfolio flows and then affected domestic returns and its variance.

Amanulla S. and Kamaiah. B (1997) analysed the weak form efficiency of the Indian stock market by employing ARIMA and Ljung Box Test statistics. The monthly stock return of 53 stocks traded on the BSE as well as two stock markets price indices - BSE as well two stock market price indices. The results of the tests supported that the Indian stock market was efficient in weak form.

Charless P. Johnson, Mark D.William and Jack Wilson (2004) developed a simple measure of volatility based on extreme day returns and applied it to market returns from 1985 to 2002 on S&P 500 index and Dow Jones Industrial Average (DJIA) for a period of 18 years. They showed that volatility changed from 1985 to 2002 with no secular trend, that there was some persistence volatility was higher in bear markets than in bull markets.

Kiran Kumar (2002) investigated the short run dynamic inter linkages between the U.S and Indian stock market using day time and over night time returns of the S P CNX Nifty and NASDA Composite from July 1990 to June 2001. The study showed that the US stock markets significantly influenced Indian stock markets and not vice-versa.

Ramasastri, examined (1999) market efficiency in the Nineties testing through unit roots, the weak form efficiency of the Indian stock market wake of reforms was introduced to stock market in nineties. The study attempts to test efficiency of market during three distinct periods January 1991 tom December 1992 January 1993 December 1995 and January 1996 to December 1998, the test result was found that there were no evidence to reject the efficient market hypothesis during these period based on Sensex data. Pakistan and Sri Lanka were relatively isolated from the major developed markets during the entire sample period of July 1997 - February 2003.

Chuang et al. (2007) investigated stock indices of Japan, Hong Kong, Singapore, South Korea, Taiwan and Thailand from January 3, 1992 to June 10, 2006 using six variable VAR-BEKK models, Error-Correction Model (ECM), VAR analysis and the impulse response functions. The empirical results evidenced volatility clustering effects. The Japanese market was most influential in transmitting volatility to the other East Asian markets.

Gannon (2010) was developed simultaneous volatility models that allow for simultaneous and unidirectional volatility and volume of trade effects. Intraday data from the Australian cash index and index futures markets are used to test these effects. Overnight volatility spillover effects were tested with the data from the S and P 500index using alternative estimates of the United States volatility. He found that the simultaneous volatility model is robust to alternative specifications of returns equations and to misspecification of the direction of volatility causality.

Sabbaghi (2011) studied G5 stock markets, namely the UK, Germany, France, Japan and the US, in the light of the global financial crisis of 2008 for a sample period from January 4, 2008 to December 31, 2010 using GARCH and EGARCH (1, 1) models. Volume was evidenced to be an important variable in explaining conditional volatility. Results suggested that trading volume captured a significant fraction of asymmetric volatility effects during the recent financial crisis.

Seda (2012) examined the impact of crisis on the Czech and Polish stock markets for the period of around eight years from 2004 to 2012 using AR (1) - GARCH (1, 1) and Jump-Diffusion GARCH (1, 1) model with heteroskedasticity. The results showed no statistical significant jump behavior in both markets before the crisis but the opposite was found during the crisis.

Saadah (2013) investigated the Singaporean and Indonesian stock market for the sample period from January 3, 2008 till August 15, 2012 using ARMA-TGARCH (1, 1) model and Langrange multiplier. The results evidenced that the transmission of the shock from the Singapore stock exchange became stronger when this market experiences a negative return and is in the bearish phase.

Ding et al. (2014) scrutinized the stock option indices of US, European, German, Japanese, and Swiss equity markets from January 1999 to December 2009 using multivariate GARCH model, general VAR (1)-VECH (1, 1) and GARCH model. The results showed asymmetric bi-directional relation between the VIX and other market volatility indices, in which VIX has a larger impact in both the pre-crisis and during crisis times.

Hwang (2014) examined the Latin American stock markets of Argentina, Brazil, Chile, Mexico and USA in the light of crisis for a period from January 1, 2006 to December 31, 2010 using co-integration

GARCH-BEKK and DCC-GARCH models. Evidence of financial contagion during crisis was reported. Conditional correlations were more volatile during the crisis.

Sakthivel et al. (2014) studied the volatility of Indian stock markets for the period March 1, 2005 to December 31, 2012 using GJR GARCH model and dummy variable. The results concluded that leverage effects, increased volatility and negative impact on mean returns were the outcomes of crisis.

Golosnoy et al. (2015) studied USA, German and Japanese stock markets before and during the subprime crisis for a period from January 5, 1996 to February 26, 2009 using a novel four-phase model based on conditional autoregressive framework. They have seen spillovers from one market to the next trading market were found to be short-lived and which intensified during crisis. And the crisis decreased the persistence in volatility.

2. RESEARCH QUESTION AND CONTRIBUTION

- Does the small-cap indices are efficient in the weak form?
- Does the relationship exist between Emerging countries small-cap index and Developed Countries small cap indices in the form volatility and return profile?

The study's main contribution is to examine the dynamic relationships between Emerging countries small cap indices and the Developed economics small cap indices. The results from this study implies on how the small cap stocks act as on every country market, and it also implies for international portfolio diversifications and portfolio management.

3. DATA AND METHOD

Only Secondary data were used. The data consisted of daily series of BSE-Small-Cap index, and International market Small-Cap indices which are from MSCI (Morgan Stanley Capital International) are used for analysis. Morgan Stanley Capital International Inc., (MSCI) is a leading provider of global equity, US equity, fixed income hedge fund and multi-asset class indices, and benchmark related products and services to investors' worldwide. MSCI provides global equity indices, which over the last 30 years have become the most widely used international equity benchmarks by institutional investors. The market index series were measured in dollar currency terms and no major discrepancies were found in the data. The study period is from 2009 to 2015 and the historical data used leading emerging countries such as Brazil, China, India, Indonesia, Korea, Malaysia, Philippines, Russia, South Africa and Taiwan and leading industrialized countries such as Australia, Belgium, Finland, France, Germany, Italy, Netherland, Norway, Switzerland and United Kingdom.

Data for Analysis

The time series data used for modelling volatility in this paper is the daily closing prices of Small-Cap indices over the period from 2nd January 2009 to 31st December, 2014, resulting . These closing prices have been taken from MSCI website. In this study, daily returns (r_t) were calculated as the continuously compounded returns which are the first difference in logarithm of closing prices of MSCI Small Cap closing prices of successive days :

$$r = \log_t \left(\frac{P_t}{P_{t-1}} \right) \quad (1)$$

where P_t and $P_t - 1$ are the closing market index of KSE at the current day and previous day, respectively.

Volatility Modeling Techniques

The existing models of volatility can be divided into two main categories, symmetric and asymmetric models. In the symmetric models, the conditional variance only depends on the magnitude, and not the sign, of the underlying asset, while in the asymmetric models the shocks of the same magnitude, positive or negative, have different effect on future volatility.

Symmetric GARCH Models

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) Model

In this model, the conditional variance is

represented as a linear function of its own lags. The simplest model specification is the GARCH (1,1) model

Mean equation $r_t = \mu + \varepsilon_t$ (2)

Variance equation = $\sigma_t^2\ \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$ (3)

where $\omega > 0$ and $\alpha_1 \geq 0$ and $\beta_1 \geq 0$, and.

r_t = return of the asset at time t.

μ = average return.

ε_t = residual returns, defined as:

$$\varepsilon_t = \sigma_t z_t \quad (4)$$

where z_t is standardized residual returns (*i.e.* iid random variable with zero mean and variance 1), and σ_t^2 is

In this model, the mean equation is written as a function of constant with an errorterm. Since σ_t^2

period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified as a function of three terms:

- A constant term : ω
- News about volatility from the previous period, measured as the lag of the squared residula from the mean equation: ε_{t-1}^2 (the ARCH term)
- Last period forecast varince: σ_{t-1}^2 (the GARCH term).

The conditional variance equation models the time varying nature of volatility of the residuals generated from the mean equation. This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted average of a long term average (the constant), the forecast variance from last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period.

The GARCH-in-Mean (GARCH-M) Model

In finance, the return of a security may depend on its volatility. To model such a phenomenon one may consider the GARCH-M Model of Engle, Lilien, and Robins 1987 , where "M" stands for GARCH in the mean.

This model is an extension of the basic GARCH framework which allows the conditional mean of a sequence to depend on its conditional variance or standard deviation. A simple GARCH-M (1,1) model can be written as :

where μ and λ are constants. The parameter λ is called the risk premium parameter. A positive λ indicates that the return is positively related to its volatility. In other words, a rise in mean return is caused by an increase in conditional variance as a proxy of increased risk.

Engle, Lilien, and Robins assume that the risk premium is an increasing function of the conditional variance of ε_t; in other words, the greater the conditional variance of returns, the greater the compensation necessary to induce the agent to hold the long - term asset [5]. Other specifications of risk premium have also been used in the literature, including:

$$r_t = \mu + \lambda \sigma_t + \varepsilon_t \quad (5)$$

And $$r = \mu + \lambda\ 1n\ \sigma^2 + \varepsilon_t \quad (6)$$

Testing for Stationary

Given the time series nature of the data, the first step in the analysis is to determine the descriptive statistics and the variables are tested for normalityThen the stationarity of the time series is tested using the Augmented Dickey-Fuller test and Schmidt-Phillips test. The null hypothesis to be sued is that there is a unit root in the series (*i.e.* series is non-stationary), while the alternative hypothesis is that there is no unit root. If spot and futures prices are found to be integrated of the same order, co-integration test using the Johansen procedure are performed. One of the most widespread unit root test is the Augmented Dickey Fuller (ADF) test. The standard Dickey Fuller test estimates following equation:

$$\Delta x_t = (\alpha - 1) x_{t-1} + \varepsilon_t$$

The case where corresponds to the random walk which is non-stationary. The Dickey Fuller test tests whether this t-statistic does not converge to the normal distribution but instead to the distribution of a functional of Wiener process.

The Dickey Fuller test is only valid for AR(1) processes. If the time series is correlated at higher lags, the augmented Dickey Fuller test constructs a parameter correction for higher order correlation, by adding lag differences of the time series:

$$\Delta x_t = (\alpha - 1)x_{t-1} + \sum_{j-1}^{p} \beta_j \Delta x_{t-j} + \varepsilon_t$$

The order of p could be chosen by minimising information criteria such as Akaike or Schwarz.

The basic idea is that futures and cash prices can share a long-run relationship if they are found to be co-integrated, i.e. if there is a linear combination of them which is stationary. There are several methods available for conducting the co-integration test, the most widely used method include the residual based Engle-Granger (1987) test and Johansen- Juselius (1990) tests. Then Engle-Granger co-integration test consists of a two stop procedure. In the first step, the residual error is tested for stationarity. Variables Y and X might individually be non-stationary but if the estimate of their residual error is stationary, Y and X are said to be co-integrated. It implies that Y and X form a long run relationship and the regression is not spurious.

4. RESULTS AND DISCUSSION

Results and Discussions

Table-1(a) : Descriptive Statistics on Five years price of Emerging Country Small-Cap Indices

Country	Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kutosis
Brazil	1319.047	1374.455	1815.659	357.8190	357.8081	-1.079921	3.513678
China	1082.039	1098.643	1510.065	464.3960	214.3059	-0.375654	3.119890
India	879.7810	881.0480	1348.912	323.5960	204.6035	-0.317226	2.991512
Indonesia	1096.226	1199.323	1527.255	366.9560	261.7466	-0.950465	3.415726
Korea	773.7176	783.7740	1045.255	353.8690	111.2908	-0.982189	5.097474
Malaysia	1084.237	1146.839	1372.070	477.5210	233.9977	-0.822377	2.721503
Philippines	1157.509	1292.048	1902.776	320.9920	414.7052	-0.350443	2.009336
Russia	519.7909	503.7430	883.4980	122.0270	184.9032	0.046692	2.278035
South Africa	895.4646	939.7840	1130.115	403.1250	167.5521	-0.974629	3.221519
Taiwan	986.9213	982.1470	1291.691	466.7170	168.8905	-0.614986	3.796418

Table-1(b) : Descriptive Statistics on Five years price of Developed Country Small-Cap Indices

Country	Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kutosis
Australia	266.0669	299.607	354.217	132.681	66.10067	-0.52882	1.805946
Belgium	115.9307	127.249	145.502	66.411	23.07856	-0.57062	1.93673
Finland	342.2422	381.663	445.711	185.628	82.64061	-0.48359	1.722918
France	193.4381	207.141	245.233	113.727	36.50235	-0.56798	1.978522
Germany	96.98542	106.093	122.509	52.969	20.30136	-0.58439	1.978522
Italy	282.5238	294.391	371.055	167.31	42.52477	-0.80028	2.974283
Netherland	110.3394	121.897	138.106	60.298	23.27352	-0.59026	1.877754
Norway	151.166	156.223	214.604	72.736	39.63131	-0.2933	1.839649
Switzerland	322.5814	348.844	414.363	189.99	59.57488	-0.58531	2.187036
United Kingdom	150.3697	162.653	187.204	88.699	26.48873	-0.83139	2.43032

Table-2(a)
Descriptive Statistics on Five years Return of Emerging Country Small-Cap Indices

Country	Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kutosis
Brazil	0.14	0.19	7.09	-8.78	1.60	-0.37	5.61
China	0.07	0.09	5.23	-5.68	1.42	-0.38	4.85
India	0.07	0.06	14.69	-7.18	1.71	0.31	9.24
Indonesia	0.11	0.11	9.61	-9.44	1.83	-0.39	7.54
Korea	0.07	0.14	7.60	-8.60	1.71	-0.63	6.34
Malaysia	0.09	0.07	4.50	-4.75	1.18	-0.27	5.34
Philippines	0.16	0.13	6.70	-6.31	1.42	-0.18	4.96
Russia	0.11	0.09	10.02	-12.12	2.28	-0.32	5.97
South Africa	0.08	0.16	5.39	-6.36	1.39	-0.17	4.21
Taiwan	0.07	0.16	7.91	-6.53	1.50	-0.62	5.95

Table-2(b)
Descriptive Statistics on Five years Return of Developed Country Small-Cap Indices

Country	Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kutosis
Australia	0.07	0.09	7.30	-8.40	1.56	-0.24	5.47
Belgium	0.05	0.08	9.47	-5.90	1.54	-0.09	5.26
Finland	0.05	0.05	10.16	-7.95	1.92	0.02	5.00
France	0.08	0.10	8.04	-6.98	1.69	-0.23	4.61
Germany	0.08	0.13	7.51	-6.40	1.69	-0.23	4.61
Italy	0.03	0.11	7.64	-6.18	1.63	-0.27	4.88
Netherland	0.05	0.11	7.64	-6.18	1.63	-0.27	4.88
Norway	0.07	0.13	9.91	-9.11	2.15	-0.28	5.25
Switzerland	0.07	0.11	5.77	-7.44	1.31	-0.37	5.44
United Kingdom	0.09	0.14	7.29	-6.31	1.44	-0.25	4.87

The Descriptive statistics result shows that the Skewness and Kurtosis are clearly observed in both the data series, which is a confirmation of the stylized fact, related to fat tails and extreme values with high frequencies data. Skewness measures asymmetry of a distribution. It is also noticed that the indices performance seems to be more volatile on the considered period regarding standard deviation. In emerging country indices (table-1(a), Brazil, China and Philippines are showing high deviation rate. Similarly, Finland, Switzerland and Italy are developed country indices showing the high deviation rate.

In the return series, mean value is high in Philippines, Brazil and Indonesia and also showing the high deviation rate. Russia is showing highest deviation, at same time showing comparatively low return. The low deviation is shown in South Africa and Korea.

In the Developed indices, the range of return is between 0.03 and 0.09. Switzerland is showing the good return and less deviation rate. Norway is showing high deviation.

TESTING FOR STATIONARY

Table-3(a)
Augmented Dickey – Fuller Test Statistics

Brazil	China	India	Indonesia	Korea	Malaysia	Philippines	Russia	South Africa	Taiwan
-2.77* (0.0628)	-2.60* (0.0913)	-2.09 (0.2464)	-2.70* (0.0738)	-3.39** (0.0112)	-2.51** (0.1123)	-1.97 (0.2995)	-1.98 (0.2911)	-2.57* (0.0976)	-3.25** (0.0171)
Stationary	Stationary	Non-Stationary	Stationary	Stationary	Stationary	Non-Stationary	Non-Stationary	Stationary	Stationary

Table-3(a) (i)
Augmented Dickey – Fuller Test Statistics – Log Differenced Prices

India	Malaysia	Philippines	Russia
-31.69 (0.0000)	-32.58 (0.0000)	-29.74 (0.0000)	-26.63 (0.0000)
Stationary	**Stationary**	**Stationary**	**Stationary**

Table-3(b) (i)
Augmented Dickey – Fuller Test tatistics

Australia	Belgium	Finland	France	Germany	Italy	Netherland	Norway	Switzerland	United Kingdom
-2.43 (0.1322)	-2.84 (0.1190)	-2.42 (0.1354)	-0.46 (0.8944)	-1.32 (0.6115)	-1.28 (0.6363)	-2.17 (0.2204)	-2.57 (0.0993)	-1.36 (0.6039)	-0.51 (0.8878)
Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Stationary	Non-Stationary	Non-Stationary

Table-3(b) (ii)
Augmented Dickey – Fuller Test Statistics – Log Differenced Prices

Australia	Belgium	Finland	France	Germany	Italy	Netherland	Switzerland	United Kingdom
-33.289 (0.0000)	-34.40 (0.0000)	-33.80 (0.0000)	-33.30 (0.0000)	-33.84 (0.0000)	-34.36 (0.0000)	-34.25 (0.0000)	-33.95 (0.0000)	-33.85 (0.0000)
Stationary	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**

Test critical values : 1% level -3.458973
5% level -2.874029
10% level -2.573502

*MacKinnon (1996) one-sided p-values

Table-4(a) (i)
Phillips-Perron Unit Root Test Statistics

Brazil	China	India	Indonesia	Korea	Malaysia	Philippines	Russia	South Africa	Taiwan
-2.79 (0.0590)	-2.62 (0.0889)	-2.10 (0.2447)	-2.70 (0.0740)	-3.39 (0.0112)	-2.47 (0.1221)	-1.97 (0.3027)	-2.01 (0.2784)	-2.57 (0.0975)	-3.25 (0.0175)
Stationary	Stationary	Non-Stationary	Stationary	Stationary	Stationary	Non-Stationary	Non-Stationary	Stationary	Stationary

Table-4(a) (ii)
Phillips-Perron Unit Root Test Statistics – Log Differenced Prices

India	Malaysia	Philippines	Russia
-32.07 (0.0000)	-32.98 (0.0000)	-29.89 (0.0000)	-26.54 (0.0000)
Stationary	**Stationary**	**Stationary**	**Stationary**

Table-4(b) (i)
Phillips-Perron Unit Root Test Statistics

Australia	Belgium	Finland	France	Germany	Italy	Netherland	Norway	Switzerland	United Kingdom
-2.37 (0.0000)	-2.45 (0.1283)	-2.40 (0.1396)	-0.47 (0.8942)	-1.25 (06518)	-1.37 (0.5954)	-2.21 (0.2027)	-2.48 (0.1186)	-1.39 (0.5842)	-0.39 (0.9082)
Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary

Table-4(b) (ii)
Phillips-Perron Unit Root Test Statistics – Log Differenced Prices

Australia	Belgium	Finland	France	Germany	Italy	Netherland	Norway	Switzerland	United Kingdom
-33.20 (0.0000)	-34.42 (0.0000)	-33.75 (0.0000)	-33.22 (0.0000)	-33.88 (0.0000)	-34.36 (0.0000)	-34.26 (0.0000)	-33.24 (0.0000)	-33.95 (0.0000)	-33.88 (0.0000)
Stationary	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**	**Stationary**

Test critical values :	1% level	-3.458973
	5% level	-2.874029
	10% level	-2.573502

*MacKinnon (1996) one-sided p-values

The following hypothesis is postulated

Null Hypothesis H_0 – There is a unit root in the series (Non-Stationary)

Alternate Hypothesis H1 – There is no unit root in the series (Stationary)

The Augmented Dickey- Fuller Test (ADF) statistic values the observed the four indices are showing non-stationary namely, India, Malaysia, Philippines and Russia. Other six indices are showing the stationary. In the Developed country indices have all the data are showing non-stationary, except Norway. So transform log is essential to know the movements of values, we applied the log differenced in values, the result observed the stationary results. The result of stationary can be seen that the T-test significance at 5% confidence level is less than the significant value (1.96). And hence we will reject the null hypothesis and accept the alternate hypothesis. Thus, it can be concluded that the all the indices data are stationary.

The Phillips-Perron (PP) statistic value is statistic the observed in the emerging economic countries, the four indices are showing non-stationary namely, India, Malaysia, Philippines and Russia. Other six indices are showing the stationary. In the Developed economic country indices, all the indices data are showing non-stationary. So transform log is essential to know the movements of values, we applied the log differenced in values. The critical values at the 1%, 5% and 10% levels are -3.458973, -2.874029 and -2.573502. It can be seen that the statistic value t? is greater than the critical value at 5% so we do reject the null at 5% significance level and conclude that all the indices prices are moving stationary.

GARCH (1,1) Results

Table-5(a) (i)
Estimation Results of GARCH Model (1, 1)

Country Indices	Constant	ARCH Effect (α)	GARCH Effect (β)	(α+β)	Log Likelihood
Brazil	9005.749 (2478.439)	1.1525 (3.519)*	-0.0446 (0.202)	1.0784	-8538.060
China	105.522 (26.2178)	0.8880 (0.1688)	0.1158 (0.0494)	1.0038	-7906.365
India	118.4366 (41.3811)	0.96852 (0.1797)	0.0292 (0.0580)	0.9977	-8080.997
Indonesia	60.9216 (20.6679)	0.6246 (0.0929)	0.3907 (0.0367)	1.0153	-8176.319
Korea	415101.0 (850147.6)	1.1091 (2.6903)**	-0.6970 (2.5607)	0.4121	-10555.47
Malaysia	104.2504 (20.1372)	0,9355 (0.1847)	0.0537 (0.0799)	0.9892	-7933.172
Philipines	284.6620 (79.6913)	1.0001 (0.2204)	-0.0112 (0.0740)	0.9889	8718.722
Russia	1804.147 (354.1184)	1.2796 (-0.4743)	-0.4743 (0.0343)	0.8053	-6256.084
South Africa	147.9692 (20.3136)	1.0460 (0.1560)	-0.0721 (0.0393)	0.9740	-7202.454
Taiwan	72.6078 (11.4952)	0.8669 (0.1354)	0.1431 (0.0400)	0.1010	-7383.731

Table-5(a) (ii)
ARCH – LM Test for Residual of Returns

H_0 : There is No ARCH Effect H_1 : There is an ARCH Effect

Country Indices	F Statistic	ARCH – LM Statistic	Prob. Chi-Square (1)	ARCH Effects
Brazil	1179.3620	718.3182	0.0000	H0- Rejected
China	12.9818	12.8711	0.0003	H0- Rejected
India	6.1077	6.0885	0.0136	H0- Rejected
Indonesia	27.0711	26.5604	0.0000	H0- Rejected
Korea	6332.174	1081.604	0.0000	H0- Rejected
Malaysia	0.0808	0.0809	0.7760	H0- Accepted
Philipines	0.6153	0.6160	0.4325	H0- Accepted
Russia	140.9422	123.986	0.0000	H0- Rejected
South Africa	0.0009	0.0009	0.9749	H0- Accepted
Taiwan	10.4610	10.3922	0.0013	H0- Rejected

Table-5(b) (i)
Estimation results of GARCH Model (1, 1)

Country Indices	Constant	ARCH Effect (α)	GARCH Effect (β)	(α+β)	Log Likelihood
Australia	13.8806 (2.3788)	0.9325 (0.1574)	0.0753 (0.0495)	1.0078	-6270.177
Belgium	3.5672 (0.5398)	1.0363 (0.1600)	-0.0385 (0.0359)	0.9978	-1.0724
Finland	409.2641 (65.9541)	1.1574 (0.1460)	-0.4563 (0.0450)	0.7011	-6512.178
France	14.1379 (2.8937)	0.9799 (0.1868)	0.0139 (0.0789)	0.9938	-6082.414
Germany	47.9281 (8.8067)	1.3122 (0.1824)	-0.5057 (0.0657)	0.8065	-5368.046
Italy	9.7263 (2.8549)	0.8654 (0.1480)	0.1543 (0.0422)	1.0197	-6190.934
Netherland	20.3879 (3.8333)	1.1091 (0.1531)	-0.3286 (0.0456)	0.7805	-4922.530
Norway	7.017 (1.3621)	0.8137 (0.1315)	0.1906 (0.0410)	1.0043	-5688.549
Switzerland	24.5629 (7.7255)	0.9607 (0.1824)	0.0394 (0.0714)	1.0001	-6614.181
United Kingdom	92.2257 (23.5834)	1.3728 (0.2299)	-0.5519 (0.0720)	0.8209	-5980.284

Table-5(b) (ii)
ARCH – LM Test for Residual of Returns

Country Indices	F Statistic	ARCH – LM Statistic	Prob. Chi-Square (1)	ARCH Effects
Australia	25.6056	25.1499	0.0000	H0- Rejected
Belgium	0.2152	0.2155	0.6424	H0- Accepted
Finland	226.1000	192.3229	0.0000	H0- Rejected
France	2.1256	2.1254	0.1449	H0- Accepted
Germany	187.4508	163.6805	0.0000	H0- Rejected
Italy	13.1347	13.0211	0.0003	H0- Rejected
Netherland	137.7559	124.5186	0.0000	H0- Rejected
Norway	8.0700	8.0319	0.0046	H0- Rejected
Switzerland	6.4307	6.4084	0.0114	H0- Rejected
United Kingdom	90.89212	84.9768	0.0000	H0- Rejected

Table-6(a) (i)
Auto Correlation Box-Ljung Results

BRAZIL		CHINA		INDIA		INDONESIA		KOREA	
AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG
0.146 (5.22)	27.319	0.105* (3.75)	13.992	0.125* (4.46)	20.396	0.043 (1.54)	2.380	0.036 (1.29)	1.666
0.011 (0.40)	27.464	0.048 (1.72)	16.886	0.105 (3.75)	34.732	0.065* (2.32)	7.978	-0.014 (-0.50)	1.931
-0.009 (-0.32)	27.567	0.04 (1.43)	18.959	0.069 (2.46)	41.012	0.004 (0.14)	7.996	0.051 (1.82)	5.303
0.002 (0.07)	27.574	0.011 (0.40)	19.110	0.03 (1.07)	42.177	-0.015 (-0.54)	8.297	-0.031 (-1.11)	6.536
-0.012 (-0.43)	27.746	0.011 (0.39)	19.266	0.028 (1.00)	43.225	0.054 (1.93)	12.153	-0.023 (-0.82)	7.238
0.034 (1.21)	29.193	-0.003) (-0.10)	19.282	-0.023 (-0.82)	43.938	-0.039 (-1.39)	14.166	-0.004 (-0.14)	7.263
0.025 (0.89)	30.024	0.076* (2.71)	26.640	0.072 (2.57)	50.661	0.071* (2.54)	20.710	0.06* (2.46)	13.470
0.04 (1.43)	32.092	-0.005 (-0.17)	26.679	0.038 (1.36)	52.542	0.001 (0.04)	20.713	-0.004 (-0.14)	13.487
0.038 (1.35)	33.971	0.061 (2.17)	31.439	0.074 (2.64)	59.654	0.026 (0.93)	21.625	0.042 (1.50)	15.757
0.021 (0.75)	34.548	0.114* (4.07)	48.254	0.007 (0.25)	59.710	0.036 (1.29)	23.307	0.022 (0.79)	16.411
0.034 (1.21)	36.043	-0.026 (-0.93)	49.104	-0.006 (-0.21)	59.759	-0.06* (-2.43)	29.431	-0.022 (-0.79)	17.063
0.048 (1.71)	39.041	0.013 (0.47)	49.324	0.026 (0.93)	60.671	0.07* (2.57)	36.327	0.038 (1.36)	18.968
0.055* (1.96)	42.934	0.072* (2.58)	55.961	0.021 (0.75)	61.244	0.02 (0.71)	36.864	-0.02 (-0.71)	19.521
0.029 (1.03)	44.014	0.039 (1.40)	57.974	-0.022 (-0.79)	61.873	0.016 (0.57)	37.214	0.054 (1.93)	23.307

*significant 5% level

Table-6(a) (ii)
Auto Correlation Box-Ljung Results

MALAYSIA		PHILLIPNES		RUSSIA		SOUTH AFRICA		TAIWAN	
AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG
0.103* (3.68)	13.790	0.194 (6.93)	48.356	0.134 (4.32)	18.283	0.045 (1.61)	2.641	0.08 (2.86)	8.126
0.072* (3.68)	20.645	0.058 (2.07)	52.652	0.013 (0.42)	18.447	0.034 (1.21)	4.154	0.033 (1.18)	9.549
0.037 (1.32)	22.403	0.008 (0.29)	52.733	0.025 (0.81)	19.062	0.022 (0.79)	4.765	0.034 (1.21)	11.074
-0.017 (-0.61)	22.765	-0.03 (-1.07)	53.896	0.036 (1.16)	20.417	-0.031 (-1.11)	5.990	0.036 (1.29)	12.694
0.039 (1.39)	24.712	-0.038 (-1.36)	55.788	-0.002 (-0.06)	20.420	-0.019 (-0.68)	6.477	0.073 (2.61)	19.470
0.011 (0.39)	24.869	0.006 (0.21)	55.836	-0.039 (-1.26)	21.966	-0.046 (-1.64)	9.243	0.027 (0.96)	20.437
0.074* (2.64)	32.005	0.045 (1.61)	58.438	-0.035 (-1.13)	23.203	-0.003 (-0.11)	9.255	0.064 (2.29)	25.746
0.002 (0.07)	32.011	0.069 (2.46)	64.509	0.065 (2.10)	27.543	-0.007 (-0.25)	9.317	0.001 (0.04)	25.747
0.005 (0.18)	32.048	0.051 (1.82)	67.870	0.035 (1.13)	28.808	-0.006 (-0.21)	9.359	-0.02 (-0.71)	26.253
0.02 (0.71)	32.587	0.021 (0.75)	68.438	-0.017 (-0.55)	29.106	-0.003 (-0.11)	9.371	0.034 (1.21)	27.745
-0.038 (-1.36)	34.479	0.057 (2.04)	72.645	0.032 (1.03)	30.145	0.009 (0.32)	9.479	0.009 (0.32)	27.861
0.034 (1.21)	35.989	0.061 (2.18)	77.391	0.052 (1.68)	32.964	0.006 (0.21)	9.526	0.067 (2.39)	33.651
0.059* (2.11)	40.505	0.082 (2.93)	86.049	0.081 (2.61)	39.670	-0.015 (-0.54)	9.817	0.08 (2.86)	41.848
0.067* (2.39)	46.454	0.044 (1.57)	88.554	0.037 (1.19)	41.074	-0.017 (-0.61)	10.180	0.036 (1.29)	43.540
0.003 (0.11)	46.467	0.022 (0.79)	89.167	0.02 (0.65)	41.482	-0.022 (-0.79)	10.798	0.033 (1.18)	44.978
-0.081* (-2.89)	55.189	-0.039 (-1.39)	91.092	-0.028 (-0.90)	42.301	-0.027 (-0.96)	11.727	-0.032 (-1.14)	46.310

*significant 5% level

Table-6(b) (i)
Auto Correlation Box-Ljung Results

AUSTRALIA		BELGIUM		FINLAND		FRANCE		ITALY	
AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG
0.081 (2.90)	8.650	0.03 (1.08)	1.150	0.054 (1.93)	3.694	0.063 (2.25)	5.040	0.047 (1.68)	2.799
0.033 (1.18)	10.077	0.008 (0.28)	1.223	0.019 (0.68)	4.149	0.023 (0.82)	5.706	-0.019 (-0.68)	3.247
-0.04 (-1.43)	12.224	-0.059 (-2.10)	5.620	-0.041 (-1.47)	6.313	-0.067 (-2.39)	11.466	-0.072 (-2.57	9.872
-0.012 (-0.43)	12.410	-0.032 (-1.15)	6.936	-0.026 (-0.93)	7.211	-0.021 (-0.75)	12.029	-0.019 (-0.68)	10.342

-0.024 (-0.86)	13.145	-0.031 (-1.11)	8.192	-0.088 (-3.14)	17.053	-0.028 (-1.00)	13.015	-0.046 (-1.64)	13.090
-0.029 (-1.04)	14.268	0 (0)	8.192	-0.019 (-0.68)	17.541	-0.002 (-0.07)	13.019	-0.015 (-0.54)	13.363
-0.008 (-0.29)	14.349	-0.001 (-0.03)	8.194	0.012 (0.43)	17.732	0.004 (0.14)	13.037	-0.011 (-0.39)	13.505
-0.01 (-0.36)	14.468	-0.035 (-1.25)	9.743	-0.015 (-0.54)	18.040	0 (0.00)	13.037	-0.004 (-0.14)	13.526
-0.011 (-0.40)	14.627	0.033 (1.18)	11.176	0.034 (1.22)	19.561	0.021 (0.75)	13.625	0.027 (0.96)	14.440
-0.005 (-0.18)	14.663	-0.022 (-0.79)	11.773	-0.025 (-0.89)	20.375	-0.02 (-0.71)	14.125	-0.017 (-0.61)	14.800
0.043 (1.54)	17.119	0.051 (1.83)	15.149	0.055 (1.96)	24.295	0.043 (1.54)	16.511	0.043 (1.54)	17.194
0.055 (1.96)	21.068	0.019 (0.68)	15.630	0.02 (0.72)	24.824	0.028 (1.00)	17.500	0.02 (0.71)	17.714
0.037 (1.32)	22.833	0.039 (1.40)	17.632	0.022 (0.78)	25.453	0.03 (1.07)	18.676	0.035 (1.25)	19.328
0.023 (0.82)	23.519	-0.012 (-0.43)	17.808	0.012 (0.43)	25.629	-0.018 (-0.64)	19.073	-0011 (-0.39)	19.486
0.009 (0.32)	23.637	0.003 (0.10)	17.823	0.016 (0.58)	25.947	0.02 (0.75)	19.576	0.022 (0.79)	20.095
0.017 (0.61)	24.020	0.033 (1.18)	19.208	0.024 (0.85)	26.676	0.032 (1.14)	20.900	0.007 (0.25)	20.156

*significant 5% level

Table-6(b) (ii)
Auto Correlation Box-Ljung Results

ITALY		NETHERLAND		NORWAY		SWITZERLAND		UNITED KINGDOM	
AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG	AUTO CORR	LJUNG
0.036 (1.29)	1.680	0.034 (1.21)	1.481	0.004 (0.14)	.016	0.048 (1.71)	2.946	0.056 (2.00)	3.978
0.013 (0.46)	1.893	0.04 (1.43)	3.576	0.021 (0.75)	.568	0.019 (0.68)	3.429	-0.02 (0.71)	4.495
-0.028 (-1.00)	2.903	-0.046 (-1.64)	6.336	-0.046 (-1.64)	3.262	-0.005 (-0.18)	3.457	-0.048 (-1.71)	7.406
0 (0.00)	2.904	0.004 (0.14)	6.361	-0.022 (-0.79)	3.878	-0.013 (-0.46)	3.688	-0.045 (-1.61)	10.025
-0.027 (-0.96)	3.850	-0.033 (-1.18)	7.798	-0.059 (-2.11)	8.320	-0.015 (-0.54)	3.976	-0.039 (-1.39)	11.972
0.033 (1.18)	5.262	-0.006 (-0.21)	7.841	-0.029 (1.04)	9.396	0.019 (0.68)	4.428	-0.017 (-0.61)	12.365
0.005 (0.18)	5.300	0.013 (0.46)	8.043	-0.017 (-0.61)	9.786	0.028 (1.00)	5.420	0.016 (0.57)	12.687
-0.013 (-0.46)	5.502	0.001 (0.04)	8.045	-0.022 (-0.79)	10.419	0.003 (0.11)	5.431	-0.009 (-0.320	12.793
0.039 (1.39)	7.435	0.024 (0.86)	8.814	0.017 (0.61)	10.770	0.039 (1.39)	7.394	0 (0)	12.794
-0.049 (-1.75)	10.488	-0.032 (-1.14)	10.129	-0.003 (-0.11)	10.780	-0.022 (-0.79)	8.004	-0.001 (-0.04)	12.795
0.059 (2.11)	15.031	0.037 (1.32)	11.871	0.025 (0.89)	11.565	0.053 (1.89)	11.601	0.017 (0.61)	13.177
0.017 (0.61)	15.408	0.03 (1.07)	13.053	0.004 (0.14)	11.582	0.053 (1.89)	15.160	0.021 (0.75)	13.721

0.027 (0.96)	16.381	0.041 (1.46)	15.230	0.055 (1.96)	15.513	0.031 (1.11)	16.424	0.052 (1.86)	17.207
-0.008 (-0.29)	16.463	-0.022 (-0.79)	15.869	-0.073 (-2.61)	22.394	-0.006 (-0.21)	16.467	-0.002 (-0.070	17.214
0.003 (0.11)	16.477	0.04 (1.43)	17.945	-0.001 (-0.04)	22.396	-0.002 (0.07)	16.472	0.015 (0.54)	17.523
0.025 (0.89)	17.280	0.025 (0.89)	18.782	0.015 (0.54)	22.669	-0.008 (-0.29)	16.554	-0.016 (-0.570	17.856

*significant 5% level

The data description part when the residuals were examined for heteroscedasticity, ARCH-LM test provides strong evidence of ARCH effects in the residual series, which indicates that we can now proceed with the modeling of the indices return volatility by using GARCH methodology. The results of estimating the different GARCH models σ^2. Table 4 series, presents the estimation results for the mean and variance equations.

The first three coefficients (constant), ARCH term (α) and GARCH term (β) for GARCH (1,1) are highly significant and with expected sign for all periods. The significance of α and β indicates that lagged conditional variance and squared disturbance has an impact on the conditional variance, in other words this means that news about volatility from the previous periods has an explanatory power on current volatility. The sum of the two estimated ARCH and GARCH coefficients $\alpha+\beta$ (persistence coefficients) in the estimation process.

The estimation constant results are showing the positive for all the indices, also the variance equation results alpha and beta together the indices Brazil, China and Indonesia are showing the more than value one, the lowest ARCH and GARCH is registered in Taiwan. In the developed economy indices, Australia, Italy, Norway and Switzerland is showing the ARCH and GARCH effect value is together is more than one.

To finding the ARCH effect, to postulate the hypothesis, the hypothesis is as follows:

H_0: There is No ARCH Effect

H_1: There is an ARCH Effect

The country indices Malaysia, Philippines and South Africa are showing the result of no ARCH effect. It means the test result shows in three country indices the p value is more than the 5 per cent as a result accept the null hypothesis, other country indices are showing the ARCH effect. It means the p-value follows less than 5 per cent; it can be conclude that there is an ARCH effect. Similarly, the Developed country indices Belgium and France does not follows the ARCH effect. In other words, their p-values is shows more than the 5 per cent, obviously the, null hypothesis get accepted. All other country indices data follows the ARCH effects.

5. AUTO CORRELATION AND BOX-LJUNG RESULTS

The auto correlation and Box-Ljung test result shows that the indices of emerging country indices, seven countries are above the chi-square test value is 25. It means that the country does not follow independency, in other words, the indices does not showing the efficiency. Korea and South Africa are showing the market efficiency. In other words the Korea and South Africa market act independently, it does not follow any periodicity. Developed country indices are all proven the market efficiency. In other words, no past price has the impact on future prices.

6. CONCLUSION

Small cap indices are like hidden gems. In any country the most of the company stock lies in the (30%-40%) category of small cap stocks. Volatility and market efficiency result is important to invite retail investor in the stock market. We have analyzed 20 country small cap indices in the aspect of volatility and efficiency testing. The lowest GARCH result are shown in Taiwan, the country indices Malaysia, Philippines, and South Africa are not carrying the ARCH effect, Similarly Belgium and France does not follow the ARCH effect. It means that there is no hetroskedasticity deviation. We found that the industrialized countries have the market efficiency, it means the present price does not influence by the past price, whereas the emerging countries does not have the same. The volatility most of the countries have the reasonably long persistence of volatility.

In Market efficiency results, South Africa and Korea makes the market act independently. In developed economy country indices all the indices act the independently. The low volatility and market efficiency is good condition creates the confidence among the investors. ❍

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