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WHETHER BSE SENSEX (BSE30) AND BSE NATIONAL INDEX (BSE 100) ARE COINTEGRATED?

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ABSTRACT

Most middle income group investors prefer to invest in BSE 100 than BSE 30 due to its price affordability. But most of the information available in the market and media are focusing on BSE 30 securities and the yield on those securities. Whether using the yield data of BSE 30 securities will solve the problem of those investors who keen on investing in BSE 100 securities is the main objective of this study. The solution is the econometric and statistical tool called cointegration. If there exists a stationary linear combination of non stationary random variables, the variables combined are said to be co-integrated. The data is downloaded from BSE's official website and the period on focus is between January 1991 and July 2011. Yield is monthly yield which includes both monthly dividend yield and monthly capital gain yield. Three tests are used to find the stationary linear relationship between the non stationary variables called yield on BSE 30 securities and yield on BSE 100 securities. They are Augmented Dickey Fuller test, Engle and Granger Test and Johansen Test. We conclude that there is evidence for a cointegrating relationship if (a) The unit-root hypothesis is not rejected for the individual variables; (b) The unit-root hypothesis is rejected for the residuals (what) from the cointegrating regression. The p-value is less than 0.05 and therefore we can reject H_0 and it follows that B30 and B100 are co-integrated.

KEYWORDS

Sensex, BSE 100, Cointegration, ADF Test, Engle Granger Test.

INTRODUCTION



Over the decades, the stock market in the country has passed through good and bad periods. The journey in the 20th century has not been an easy one. Till the decade of eighties, there was no measure or scale that could precisely measure the various ups and downs in the Indian stock market. BSE, in 1986, came out with a Stock Index-SENSEX- that subsequently became the barometer of the Indian stock market.

The launch of SENSEX in 1986 was later followed up in January 1989 by introduction of BSE National Index (Base: 1983-84 = 100). It comprised 100 stocks listed at five major stock exchanges in India - Mumbai, Calcutta, Delhi, Ahmadabad and Madras. The BSE National Index was renamed BSE-100 Index from October 14, 1996 and since then, it is being calculated taking into consideration only the prices of stocks listed at BSE. BSE launched the dollar-linked version of BSE-100 index on May 22, 2006.

The main objective of the paper is to find whether any stationary linear combination exists between the non stationary random variables such as yield of BSE 30, better known as Sensex, and BSE 100. Here we include both dividend yield and capital yield into Total yield. Monthly data imported from BSE official website is used.

Middle income investors may prefer to invest in BSE National index which has 100 scripts and whose share prices may easily be affordable to those investors. So they may be interested to learn the relationship between the yield of BSE 30 and BSE 100, since there is more information on BSE 30 are available in the market than the BSE 100. The cointegration is the statistical and econometric tool which is used to clarify those doubts. If there exists a stationary linear combination of non stationary random variables, the variables combined are said to be co-integrated. To understand the phrase co-integrated of order zero, we should first define integrated series. Non-stationary series that become stationary when differenced n times are called integrated of order n . For a set of series to be co-integrated, each member of the set must be integrated of the same order n ; thus the term co-integration. A set of series, all integrated of order n , are said to be co-integrated if and only if some linear combination of the series – with non zero weights only – is integrated of order less than n . Such a linear combination is called a co-integrating relationship. So if x_t and y_t are said to be cointegrated if there exists a parameter α such that

$$U_t = y_t - \alpha x_t$$

REVIEW OF LITERATURE

Co-integration theory is definitely the innovation in theoretical econometrics that has created the most interest among economists in the last decade. A vector of $I(1)$ variables y_t is said to be cointegrated if there exist a vector β such that βy_t is trend stationary. If there exist r such linearly independent vectors β_i , $i = 1, \dots, r$, then y_t is said to be cointegrated with cointegrating rank r . The matrix $\beta = (\beta_1, \dots, \beta_r)$ is called the cointegrating matrix. Cointegrating relationships between the sequences are ruled out through Johansen's (1988) cointegration tests. Although there exists a number of cointegration tests, such as the Engle and Granger (1987) method and the Stock and Watson (1988) test, Johansen's test has a number of desirable properties, including the fact that all test variables are treated as endogenous variables. Engle and Granger (1987) compared different tests and recommended the CADF test. They supplied critical values based on Monte Carlo simulations for the case of just one regressor. Engle and Yoo (1987) extend those tables to the case of more than one regressor, and MacKinnon (1991) has the most complete tables available so far. New tests for unit roots in residuals from a potentially cointegrating relation (like the Phillips-Perron tests) have been suggested since the publication of Engle and Granger (1987) and critical values have been simulated for some of those (see Phillips and Ouliaris (1990) for critical values for the PP test - these values are built into the COINT package), but it seems that the CADF test stands up pretty well. Again, you have to be careful if the series contains trends. If the x_t series contain a trend (or may contain a trend) then we should be careful to include a trend in the cointegrating regression, otherwise the asymptotic critical values will be different. The best way of testing for unit roots is by using the system ML estimator of Johansen (1988, 1991) is a test for cointegration restrictions in a VAR representation. Johansen's estimation is treated in much detail in the book by Johansen (1995). This estimator also gives you asymptotically efficient estimates of the cointegrating vectors (the β 's) and of the adjustment parameters (the α 's). Johansen's method is the maximum likelihood estimator of the so-called reduced rank model. Even though there is a constant in the error correction representation (eqn. (3)), this may not translate into a deterministic trend in y_t . Note that this is not the same as what Campbell and Perron (1992) refer to as "deterministic cointegration", namely the case where there is trend in y_t but no trend in Δy_t . Johansen (1991) derives the likelihood ratio test (which we will denote H^*) for reduced rank in the case where there is a constant in the ECM but no trend in y_t , see Johansen (1991) or Johansen (1995) for the full explanation. Johansen (1992b) discusses how to obtain a consistent test for the number of stochastic trends and for trend in y_t at the same time. See Johansen (1991) for the derivation of the maximum likelihood estimator when there may or may not be trend. It turns out to be very convenient to program the Maximum Likelihood estimator in this case: all you have to do is to move the vector of ones in to Z_{kt} and delete it from Z_{1t} .

DATA AND METHODOLOGY

The primary objective of the study is to determine whether the yield of BSE 30 securities and BSE 100 securities are related as stationary linear combination. Then it means that both non stationary variables are cointegrated. The data is taken from BSE official website <http://www.bseindia.com/stockinfo/indices.aspx>. The formula used for finding out capital yield is $\ln(P_t / P_{t-1})$. The dividend yield is already available in the website. Total yield = dividend yield, which is taken

directly from the official website of BSE + Capital yield which is found from the formula. The Augmented Dickey-Fuller test, Engle Granger co-integration test and Johansen co-integration test. Monthly data are used for calculation and the period is from January 1991 and August 2011. Suppose that we take the total yield generated on BSE 30 and we call this as R30. And considering the alternative return on index BSE 100 and we call this as R100.

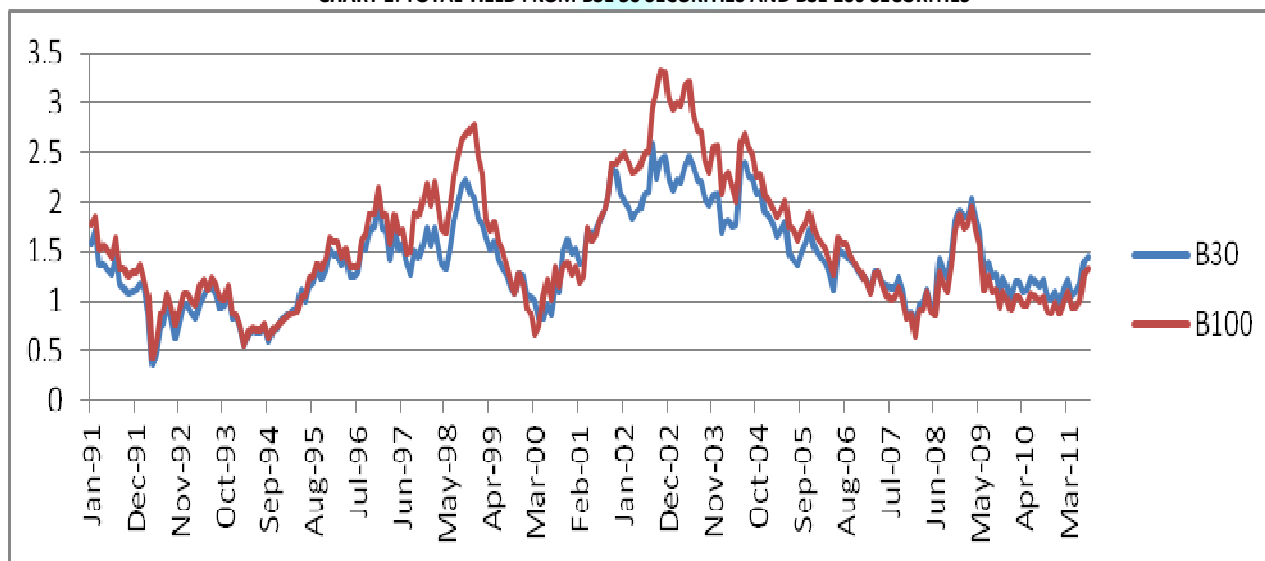
TABLE 1: COMPARISON OF MEAN OF MONTHLY YIELD OF THE SCRIP OF BSE 30 AND BSE 100

Year	Average monthly yield earned on	
	BSE 30	BSE 100
1991-1995	0.9799	1.0688
1996-2000	1.4739	1.6664
2001-2005	1.9539	2.2884
2006-2011	1.2600	1.1902

Source: Official website of Bombay Stock Exchange

The following table substantiates the cointegrating relationship of the yield of BSE 30 and BSE 100. Monthly yield on BSE 100 has been higher than the monthly yield of BSE 30. And the difference has been on the same line since 1991.

CHART 1: TOTAL YIELD FROM BSE 30 SECURITIES AND BSE 100 SECURITIES



Source: Official website of Bombay Stock Exchange

The two variables are clearly related. Total yield on BSE 30 i.e. Sensex is significantly lower than BSE 100. This is due to risk diversification and the comparatively better performance of the remaining 70 companies in the BSE 100 index. The two variables R30 and R100 are not stationary since the means are varying. Both variable appear to be I(1), though we should test for unit roots.

Analysis and discussion:

The results of Augmented Dickey – Fuller test for the random variable- B30

Statistics	Value
estimated value of (a - 1)	-0.0607032
test statistic: tau_c(1)	-2.35422
asymptotic p-value	0.1551

This is the unit root test for B30. The p value is greater than 0.05 and therefore we cannot reject Ho. This means B30 is probably I(1).

The results of Augmented Dickey – Fuller test for the random variable- B100.

Statistics	Value
estimated value of (a - 1)	-0.0487359
test statistic: tau_c(1)	-2.4068
asymptotic p-value	0.1398

This is a unit root test for B100. The p value is greater than 0.05 and therefore we cannot reject Ho. This means that B100 is probably I(1).

The following are the results of co-integrating regression.

Particulars	Coefficient	Std Error	t-ratio	p-value
Constant	0.342275	0.0230041	14.88	3.82e-036 ***
B100	0.693752	0.0138183	50.21	2.83e-131 ***

Particulars	Value	Particulars	Value
Mean dependent	1.411862	S.D. dependent	0.457396
Sum squared residual	4.594902	S.E. of regression	0.136669
R-squared	0.911081	Adjusted R-squared	0.910719
Log-likelihood	142.6749	Akaike criterion	-281.3499
Schwarz criterion	-274.3230	Hannan-Quinn	-278.5211
rho	0.869056	Durbin-Watson	0.267619

It is unlikely that Feldstein's (1996) estimates suffer by problems of spurious correlation due to R squared not exceeding 0.99, as reported by Feldstein. The following is the result of the Dickey- Fuller test on variables

Statistics	Value
estimated value of $(a - 1)$	-0.140488
test statistic: $\tau_c(1)$	-3.17046
asymptotic p-value	0.07506

The p value is less than 0.05 and therefore we can reject H_0 and it follows that B30 and B100 are co-integrated during the period between January 1991 and July 2011.

JOHANSEN TEST RESULTS

Number of equations = 2; Lag order = 12; Estimation period: 1992:01 - 2011:08 (T = 236); Case 3: Unrestricted constant

Log-likelihood = 1084.73 (including c: 414.989)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.043947	17.825	[0.0203]	10.606	[0.1779]
1	0.030123	7.2184	[0.0072]	7.2184	[0.0072]

Corrected for sample size (df = 211)

Rank	Trace test	p-value
0	17.825	[0.0210]
1	7.2184	[0.0075]

eigenvalue 0.043947 0.030123

Based on the Johansen test results, the null hypothesis that there is no cointegrating relationship between BSE 30 yield and BSE 100 yield is ruled out.

CONCLUSION

There is evidence for a cointegrating relationship if:

(a) The unit-root hypothesis is not rejected for the individual variables.

(b) The unit-root hypothesis is rejected for the residuals (\hat{u}) from the cointegrating regression.

The p-value is less than 0.05 and therefore we can reject H_0 and it follows that B30 and B100 are co-integrated.

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