An Examination of the Beta Stability in the Indian Capital Market

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Whether or not betas based on the market index remain stable over a period of time is a debated issue in the stock market. The portfolio manager assume in their analysis is that the betas remain stable over the holding period. We use the S&P BSE Sensex companies from the year 2000 to 2014 to examine whether the betas remain constant over time periods. Our results show that the betas vary across time periods and portfolio betas are less stable compared to those of the individual stocks. Therefore, historical betas need to be used with caution by the portfolio managers.

Key words*: Beta Stability, Structural Breaks, Subprime Crisis, S&P BSE Sensex Companies, Indian Capital Market.*

1. Introduction

The financial theory evidences the relationship between the returns and risk. Markowitz (1952) popularised the term risk in the capital market theory and modelled as variance in the mathematical expression to measure the risk association with the investment avenues. Later, Sharpe (1964) and Lintner (1965) formulated the Capital Asset Pricing Model (CAPM) theory which postulates the high correlation between risk and returns. The theory of CAPM demonstrates that security return is the function of market return, where beta is the indicator of the risk for investment. According to the CAPM approach the high risk (beta) premium of the securities signals the high return. This conjecture motivates the market participants for beta estimation of the security/portfolio to explore the risk and to forecast the returns.

The stock's volatility is also a risk in the security market. There is positive relationship between the volatility and risk. Higher the volatility higher the risk and, vice versa. The volatility or unexpected variation in the price is called as 'price risk' in the financial language. The price risk or volatility is measured through the beta coefficient. The beta also shows the percentage of stock's volatility with respect to the market volatility. The beta estimation facilitates the market participants to make investment decisions based on their risk averseness.

As theory states, the frequently changing beta does not help the market participants to formulate the investment decisions. Alike, the stability of the beta with time horizon signals the stability of beta and this supports the possible application of models to forecast the future. The market anomalies, recession, pressure in the market and the structural changes influence the characteristics of the beta. This evidence was provided by Mansur and Elyasiani (1994) and Dickens and Philippatos (1994) who found positive relationship between changes in banking regulations of the government and changes in the betas of the banking sector securities. This argument is supported by the results of Brooks and Faff (1995) for the Australian banking sector securities.

The seasonality in the beta series leads to unstable betas. The empirical studies have observed year-end effect and monthly seasonality in the series. For instance, Gultekin and Gultekin (1983), Roll (1983), Keim (1983) and Wood (1990) found the monthly effect on the beta series and negative impact on beta stability. This reduces the accuracy in forecasting the future returns. In contrary, Brooks et al. (1997) studied the impact of seasonal effect on beta by using monthly returns of Australian equity market. They found that the monthly seasonality does not impact the beta of individual securities. In addition, they also found that the low market capitalisation stocks show the seasonality effect in the beta.

The studies on stability beta of Indian financial markets have also showed mixed evidences (Vipul (1998), Chawla (2001) and Manickaraj and Loganathan (2004)). Harrington (1983) pointed out that the study on the beta is logical nature and important to the economic analysis. Thus, we investigate the stability of the beta by using S&P BSE Sensex companies stocks (Sensex stocks) of fourteen years. This study period is different from earlier studies and also covers the subprime crisis of 2008. We investigate pre and post crisis (2008) effect on the beta stability. Further, we find the breaks in the beta series for majority of Sensex stocks. Taneja (2010) studied the applicability of the CAPM model to Indian financial market and found that CAPM model is applicable and beta produced by the model is also valid in the Indian market. The outcome of the study about stability of beta is significant to the portfolio managers and also to the market participants.

The paper is organised as follows. The next section reviews the existing literature on stability of beta. Section 3 describes the data and methodology used in the study and section 4 presents the empirical results. Finally, section 5 concludes the paper.

2. Review of literature

The earlier researchers investigated the nature of the beta with time effect. The researchers used variety of methodologies and applied on data which had different time length of different financial markets. A few researchers studied beta influencing factors and provided the evidence. The first effort made by the Jenson (1969) about beta stability which concluded that mutual fund betas are stable. Blume (1971) examined the large data containing 42 years starting from 1926 to 1968. He found the positive relationship between estimating period and beta stability. He concluded that both security and portfolio betas are stable. Further, he added that security betas are highly stable compared to very stable portfolio betas. These results are consistent with the results of Levitz (1974).

Baesel (1974) tested the betas stationary characters of individual securities and portfolios by using monthly data. He found that the individual securities have unbalanced betas and portfolios have highly stable betas. Altman et al. (1974) demonstrated that French market betas are stable and stationary in nature. They pointed out that the individual securities exposed the character of stationarity in beta. They observed that the nature of beta produced by market model is similar in the United States markets and French markets. McDonald (1985) pointed out that the maximum likelihood method is more suitable for beta estimation compared to generalised least square method of approximation. He also pointed out that the maximum likelihood methods and generalised least square method are not sensitive to support the fluctuation of the beta. Campbell and Vuolteenaho (2004) classified the betas into two types, good and bad beta, to capture the discount-rate and cash-flow, respectively. They suggest that growth and large stocks have good betas with low risk (generate high average returns) and small stocks have bad betas with high risk and low average returns.

However, the studies on portfolios beta stability found the mixed evidences. Porter and Ezzell (1975) synchronically pointed out that portfolio of securities which are randomly selected show unstable beta. They also pointed out that number of securities in the portfolio does not influence the stability of the beta. Fabozz and Francis (1978) stated that nature of betas is random for less number of stocks. Alexander and Benson (1982) re-examined the nature of beta and argued that the findings of Fabozz and Francis (1978) are inflated. Alexander and Chervany (1980) concluded that the beta is stable in the portfolios which includes more than ten securities. Singh (2008) investigated the stationarity of the beta of 158 securities. She has found the stationarity and time-varying nature in the beta. She also pointed out that different models produce different results and the study period also influences the results. Levy (1971) studied the nature of beta by using weekly observations. He concluded that the betas generated in the portfolio returns are stable and individual securities betas are not stable. Some the empirical studies produced contradictory result on the relationship of risk premium and the returns of the securities (Campbell and Vuolteenah (2004)). The studies on the beta at Indian financial market are very less. Gupta and Mallik (1996) used 150 BSE listed companies to test the stability of the beta during 1991 to 1996. They found the instability of the beta in the study period. Gupta and Sehgal (1999) investigated the behaviour of systematic beta in relation to debt-equity ratio, net sales and current ratio. They found that all the three variables impact the stability of beta. Further, they observe that there is no relationship between beta and pay-out ratio and profitability of the company.

Vipul (1999) investigated the relationship between beta and size of the company, industry and liquidly of the securities. His study period covers 1986 to 1993 and uses 114 securities traded of BSE. He pointed out that the beta is influenced by the size of the company. He observed that securities liquidity and industry do not influence the beta stability. Chawla (2001) uses the returns on monthly data from 1996 to 2000. He pointed out that 20 stock beta are unstable out of 36 securities. Irala (2007) investigated the randomness of beta by using monthly observations of BSE data. He demonstrated that small size portfolio beta and individual securities betas are unable with the time intervals. Das (2008) concluded that eighty five percent of betas are stable in the Indian financial market. Sarma and Sarmah (2008) used five stocks that are listed in the BSE to test the stability of beta. The study period covers 2001 to 2006 and they adopt Chow test on the securities beta. They found the instability in beta for whole study period for all the stocks. They also found the stable beta for shorter time period of eighteen months interval. Mallikarjunappa and Vasantha (2013) studied stability of the beta by using stocks which are part of S&P CNX Nifty. They adopted normality test and Augmented Dickey-Fuller (ADF) test. They found that the 15 companies' betas are stable out of 50 companies and therefore, they conclude that betas are not stable in the Indian financial market.

The importance of beta stability has been widely studied in the literature. The studies cover the different periods, sub periods and applied varieties of models on individual stocks as well as portfolios. The studies are conducted on different markets and also compared results of beta stability between markets. There is no clear decisive result about stability of the beta on individual securities and portfolios. The studies confirm that the market capitalisation, firm size, market development and seasonality in the market influence the stability of the beta. In addition, the stability of the beta also differs from model to model used for estimation. In India, a few studies have analysed the beta stability. The Indian studies have shown that a few securities have stable beta and others are not. They found the correlation between estimation period and stability of the beta. These factors motivate us to investigate the stability of beta in Indian market. Thus, this study is significant and contributes to the existing literature on beta stability of Indian market.

3. Data and Methodology

The BSE Ltd (BSE) is the oldest stock exchange of Asia and has 137 years of track record in the Indian financial market. The S&P BSE Sensex index is a major stock index of BSE which represents the behaviour of Indian financial market. The Sensex stocks are identified as more liquid stocks in the BSE. Therefore, the study on beta stability of the Sensex stocks offers valid results. We use fourteen financial years' data from 1st April 2000 to 31st March 2014. However, the data differs from

companies to companies based on their listing in the (BSE). We collect the daily price series and market capitalisation data (as on 31st Mach 2014) from the Centre for Monitoring Indian Economy Pvt Ltd (Prowess) database of stocks which are constituents of Sensex that are listed on BSE. We test the hypothesis of stable beta on individual stocks and portfolios. We construct three portfolios based on the market capitalisation which comprises ten stocks each. This helps to compare the stability of beta of stocks and portfolios. In addition, we classify the data as pre and post subprime crisis of 2008, which helps to analyse the impact of subprime crisis on the stability of the beta. We investigate the presence of breaks to identify the structural changes in the CAPM beta series.

To compute the beta, we use market model which expresses the functional relationship between company returns and market returns with risk (premium). We calculate continuously compounded returns (log returns) of the series which helps to know the relative changes in the daily price series. The log returns formula is

$$r_t = \ln\left(\frac{p_t}{p_{t-1}}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where, p_t represents the price at day t and p_{t-1} price of the previous day. The market model illustrated as,

$$\overline{(r_a)} = r_f + \beta_a\left(\overline{r_m} - r_f\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where, $\overline{r_a}$ represents the expected return of the security a (or portfolio). The r_f is the risk free rate of return and $\overline{r_m}$ represents the expected market return. β_a is the coefficient that represents the risk associated with returns. Generally, CAPM assumes that the positive correlation between high beta and high return of the security or portfolio. Therefore, the stability of the beta plays significant role in estimating the returns and formulate the trading strategies. In this study, we investigate the stability of beta in the pre and post crisis period by using Chow breakpoint test. To detect the breaks (structural change) in the CAPM beta series, we use multiple breakpoint test developed by Bai (1997) and Bai and Perron (1998, 2003). We investigate the overall stability by using CUSUM test. The test equations of these models are given below.

3.1 Chow Breakpoint Test

We divide the data in to two sub periods, pre subprime crisis and post subprime crisis (2008), to test the beta stability. The Chow Breakpoint test given as

$$F = \frac{\left(S_c - (S_1 + S_2)\right)/(k)}{(S_1 + S_2)/(N_1 + N_2 - 2k)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where, S_c is the sum of squared residuals from the whole data (before making subsample) and S_1 is the sum of squared residuals from the first sample. S_2 is the sum of squared residuals from the second sample. The N_1, N_2 represents the number of observations used in the sample one and two, respectively. k is the total number of designated parameters. This test produces the results by comparing the sum of squared residuals of both the samples with the sum squared residuals of entire sample.

The null hypothesis of the Chow test is that both the least square estimator coefficients are same (linear regression models used to obtain the residuals). In other words, there are no structural break points in the data.

3.2 Multiple Breakpoint Test

Quandt (1960) improved the Chow test statistic structure to contemplate the F-statistic with the largest value to cover more break dates in the series. The Bai (1997) and Bai and Perron (1998, 2003a) demonstrated the theoretical and computational results of multiple breakpoint test that further extended the Quandt (1960) methodology. This Bai and Perron test is a technique of identification of unknown breakpoints in multiple levels of the time series.

A few studies found the monthly effect on the beta (Wood (1990)). In this study we investigate the stability of beta by observing hundred days interval. We adopt Multiple Breakpoint test, Bai and Perron test statistic, based on the linear regression with break point – (V_0)

$$Y_t = w_t{}'a + z_t'\delta_1 + \epsilon_t, \quad t = 1,2,\ldots\ldots\ V_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$Y_t = w_t{}'a + z_t'\,\delta_2 + \epsilon_t, \quad t = V_0 + 1,\ldots\ldots\ldots T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Where, Y_t is the dependent variable, w_t' *and* z_t' represents the coefficients of vector regressor, ϵ_t is unobservable disturbance term. The a, δ_1 *and* δ_2 are the unidentified parameters. The model assume that $\delta_1 \neq \delta_2$, which means there is a change in the series. The break point V_0 is also unknown in the model. The notations are solved in a matrix form.

$$yt = X_t\partial + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Where,

$$X_t = (w_t{}', z_t'), \qquad \partial = a', \delta_1{}' \qquad \delta = \delta_2 - \delta_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

$$X_t \sim I(0) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

$$t = T_{j-1} + 1,\ldots\ldots\ldots, T_j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

$$j = 1,\ldots\ldots\ldots, m+1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

$$T_0 = 0, T_{m+1,} = T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

$$(T_i - T_{i-1}) \geq h, \quad (h = \textit{minimum sample size}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

$$\textit{The break dates} = (T_1,\ldots\ldots\ldots\ldots\ldots\ldots, T_m) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

$$\text{The estimated change point} \quad V_0 = \min_{1 \leq v \leq T} S_T(k) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (14)$$

Where, $S_T(k)$ is the sum of squared residuals, while regressing Y *on* X *and* Z_2

To identify the unknown breaks, we use WD max (M, q) test, with weights that relay on the number of regressors in the series and UD max (M, q) test with an equally weighted form. M is the maximum number of breaks. q represents the number of parameters specified to know the structural change to identify the break in the series.

3.3 CUSUM Test (Cumulative Sum Test)

The CUSUM test helps to do the sequential analysis of the series. We adopt CUSUM test to find the sequential changes in the beta of the securities and also in portfolios. This is one of the well-known techniques in the literature to find the stability of the series. The standard CUSUM test statistic is developed on the recursive residuals sum as

$$\tilde{u}_t = \frac{y_t - x_t^{\top}\hat{\beta}^{(i-1)}}{\sqrt{1+x_t^{\top}\left(X^{(t-1)^{\top}}X^{(t-1)}\right)^{-1}x_t}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

Where, $t = v+1, \ldots\ldots\ldots\ldots, n)$ and y_t represents the observation of the dependent variable. x_t denotes $(1, x_{t2}, \ldots\ldots\ldots\ldots, x_{tv})^{\top}$, It is the vector of V*1 independent variables. In the model, u_t is expected to have zero mean $X^{(t)}$ denotes the regressor matrix based on all observations up to i. The $\hat{\beta}^{(i)}$ is the coefficient of ordinary least square regression based on the observation $(i+1, \ldots\ldots\ldots\ldots, i+j)$.

4. Empirical Results

The main objective of the study is to investigate beta stability of the individual stocks and portfolios. Further, this study analyses the impact of subprime crisis 2008 on stability of the beta. Lastly, we investigate the unknown break points in the beta. The table 1 reports the F- Statistic and Log likelihood ratio of the chow test framework. These F- Statistic and Log likelihood ratio tests accept the hypothesis of no breaks at specified breakpoints for sixteen companies' beta. The results of both F- Statistic and Log likelihood ratio of Chow test could not reject the hypothesis of no breaks at specified breakpoints (subprime crisis 2008) for beta of fourteen stocks. It demonstrates that the subprime crisis 2008 has impacted 47% of Sensex stocks' betas and does not impact 53% of Sensex stocks' betas.

Table 1 *Chow test Results of Sensex Stocks*

Specified Break is 2008				
Companies	**F-Statistic**	**P-Value**	**Log likelihood ratio**	**P-Value**
Wipro Ltd.	12.8399	0.0011	11.5026	0.0007
Tata Steel Ltd.	0.0612	0.8061	0.0649	0.7990
Tata Power Co. Ltd.	50.4059	0.0000	32.4524	0.0000
Tata Motors Ltd.	32.8606	0.0000	24.1861	0.0000
Tata Consultancy Services Ltd.	12.4928	0.0012	11.2366	0.0008
Sun Pharmaceutical Inds. Ltd.	41.1080	0.0000	28.3156	0.0000
State Bank of India	0.8390	0.3663	0.8787	0.3486
Sesa Sterlite Ltd.	12.2795	0.0013	11.0722	0.0009
Reliance Industries Ltd.	3.0808	0.0885	3.1239	0.0772
Oil & Natural Gas Corpn. Ltd.	8.6844	0.0059	8.1767	0.0042
N T P C Ltd.	0.9609	0.3720	1.2304	0.2673
Maruti Suzuki India Ltd.	1.2984	0.2627	1.3507	0.2452
Mahindra & Mahindra Ltd.	0.7349	0.3988	0.7788	0.3775
Larsen & Toubro Ltd.	1.7590	0.1939	1.8176	0.1776
Infosys Ltd.	1.1811	0.3004	1.3258	0.2495
I T C Ltd.	28.0090	0.0000	21.5080	0.0000
I C I C I Bank Ltd.	7.8239	0.0085	7.4466	0.0064
Housing Development Finance Corpn. Ltd.	0.6412	0.4290	0.6735	0.4118
Hindustan Unilever Ltd.	2.1092	0.1559	2.1685	0.1409
Hindalco Industries Ltd.	1.0842	0.3096	1.1578	0.2819
Hero Motocorp Ltd.	1.6442	0.2087	1.7018	0.1921
H D F C Bank Ltd.	4.4927	0.0416	4.4673	0.0345
G A I L (India) Ltd.	4.3205	0.0455	4.3062	0.0380
Dr. Reddy's Laboratories Ltd.	2.1952	0.1479	2.2540	0.1333

Axis Bank Ltd.	36.3359	0.0000	25.9859	0.0000
Coal India Ltd.	0.2738	0.6043	0.2892	0.5907
Cipla Ltd	0.2122	0.6500	0.2322	0.6299
Bharti Airtel Ltd.	27.7001	0.0000	19.9526	0.0000
Bharat Heavy Electricals Ltd.	0.1446	0.7062	0.1530	0.6956
Bajaj Auto Ltd	18.3793	0.0001	15.4955	0.0001

We constructed three portfolios to test the beta stability and sub-prime crisis effect on group of securities. The Portfolio-1 comprises the top ten market capitalisation stocks. The Portfolio-2 comprises next top ten market capitalisation stocks and Portfolio-3 comprises ten lowest market capitalisation stocks out of Sensex stocks. We apply the Chow test on these portfolios to know the effect of crisis on the beta series. The Chow test components, F-Statistic and Log likelihood ratio test results, are reported in the table 2. Based on the results reported, we accept the hypothesis of no specified breakpoints for Portfolio-1 and Portfolio-3. We reject the above hypothesis for Portfolio-2 and find the presence of structural change in the beta series. The standard deviation of three portfolio betas are less compared to that of the individual stock betas. This is true for all the Sensex stocks. There is less difference in the standard deviation of portfolios in pre and post crisis period compared to those of individual stocks. These results indicate that the construction of the portfolios positively influence the beta stability. Based on these results, we found that construction of portfolio reduce the 2008 crisis impact on portfolios beta series.

Table 2 *Chow Test Results of Portfolios*

Specified Break is 2008				
Portfolios	**F-Statistic**	**P-Value**	**Log likelihood ratio**	**P-Value**
Portfolio-1	0.3213	0.5747	0.3391	0.5603
Portfolio-2	15.5238	0.0004	13.4942	0.0002
Portfolio-3	0.4409	0.5113	0.4409	0.4955

As stated in the table 1, majority of the stock betas (54%) not affected by the subprime crisis of 2008. Therefore, we investigate the presence of unknown breaks other than the 2008 crisis in the beta series that affect the beta stability for both individual stocks and portfolios. We adopt Bai and Perron test and the results of this test for individual stocks are present in the table 3. We consider the UD max determined breaks and WD max determined breaks based on the Schwarz criterion and Liu, Wu, and Zidek (1997) proposed (LWZ) criterion. We present both with breaks and without break betas series of Sensex stocks for the study period based on the UD max and WD max results. According to the WD max results, 12 (40%) betas have no structural breaks, 13 (43%) companies have single break and 5 (17%) have double breaks in the fourteen years. The UD max results suggest that 7 (23%) of companies have no breaks, 11 (37%) companies have single break and 12 (40%) companies have double breaks in the study period. This indicates the existence of the breaks in majority of the individual stocks beta. These breaks are other than the effect of crisis of 2008 and breaks' dates are different from securities to securities.

Table 3 *Multiple Breakpoint Tests (Bai and Perron tests) Results of Sensex Companies*

Number of breaks observed based on Schwarz and LWZ criterion		
Companies	**UD max determined breaks**	**WD max determined breaks**
Wipro Ltd.	1	1
Tata Steel Ltd.	0	0
Tata Power Co. Ltd.	2	1
Tata Motors Ltd.	2	2
Tata Consultancy Services Ltd.	2	1
Sun Pharmaceutical Inds. Ltd.	2	2
State Bank Of India	2	0
Sesa Sterlite Ltd.	1	1
Reliance Industries Ltd.	2	2
Oil & Natural Gas Corpn. Ltd.	1	1
N T P C Ltd.	2	0
Maruti Suzuki India Ltd.	2	0

Mahindra & Mahindra Ltd.	0	0
Larsen & Toubro Ltd.	1	1
Infosys Ltd.	3	0
I T C Ltd.	3	2
I C I C I Bank Ltd.	2	1
Housing Development Finance Corpn. Ltd.	0	0
Hindustan Unilever Ltd.	1	1
Hindalco Industries Ltd.	1	1
Hero Motocorp Ltd.	0	0
H D F C Bank Ltd.	1	1
G A I L (India) Ltd.	1	0
Dr. Reddy's Laboratories Ltd.	1	1
Axis Bank Ltd.	1	1
Coal India Ltd.	0	0
Cipla Ltd	0	0
Bharti Airtel Ltd.	1	1
Bharat Heavy Electricals Ltd.	0	0
Bajaj Auto Ltd	2	2

The table 4 presents the identified breaks for the constructed portfolios based on the results of Bai and Perron test. We found the breaks in all the three portfolios in the period other than the crisis period of 2008. Further, the smaller market capitalisation portfolios have two breaks and high market capitalisation portfolio has one break in the study period. This shows that the specification about construction of the portfolios can influence the beta stability. This could help the portfolio managers to construct the portfolios based their specifications about risk.

Table 4 *Multiple Breakpoint Test Results of Portfolios*

Number of breaks observed		
Portfolios	Schwarz criterion	LWZ criterion
Portfolio-1	1	1
Portfolio-2	2	2
Portfolio-3	2	2

Finally, we test the beta stability in a comprehensive way by analysing structure and flow of the betas of both Sensex companies and portfolios. The table 5 reports that 19 companies (65%) have stable betas and 11 (35%) companies have unstable betas under 5% level of significance. These results are similar to the results of WD max results presented in the table 3.

Table 5 CUSUM Test of Sensex Companies

Total number of companies	30
Beta stabled companies	19*
Beta unstable companies	11*

Note: ** Represents Significant at 5% level*

The figure 1 presents the result of CUSUM test for portfolios. The results indicate that all the three portfolios have unstable betas and the CUSUM test statistic value exceeds the 5% level of significance. As per CUSUM test assumption, we expect CUSUM test result series nearer to zero mean value. The CUSUM test statistic of Portfolios-1 and Portfolios-3 are near to the expected value of zero whereas the test statistic for Portfolio-2 is higher than that of portfolios 1 and 2. The CUSUM test statistic values of Portfolio-2 have more deviation compared to the other two portfolios. The interesting fact is that more individual stocks have stable betas though, the portfolios report the instability. The majority of the stocks that are having high breaks as per the results of Bai and Perron test are the components of portfolio-2. This could be the reason for more deviation in the portfolio-2. The CUSUM test results are similar to the results of Bai and Perron test. Therefore, we can rely on the results produced in these models.

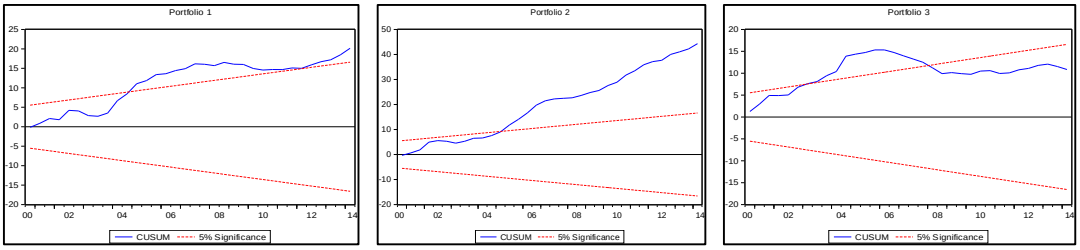

Figure 1 *The CUSUM test results of portfolios-1, 2 and 3*

5. Conclusions

In this study, we test whether the betas are stable across the time or not. We use the data of fourteen financial years from 2000 to 2014. We select stocks which are components of S&P BSE Sensex index. We estimate the CAPM beta by using 100 days estimation period for 30 stocks. We also construct the three portfolios to know the stability of the betas. We adopt Chow breakpoint test to investigate impact of subprime crisis of 2008 on beta stability. We use Multiple Breakpoint tests i.e., Bai and Perron test to find the unknown breaks in the beta series with the help of UD max (M, q) and WD max (M, q). We test the flow of the beta series without break with the help of CUSUM test.

The Chow test results prove that the subprime crisis of 2008 impacts 47% and does not impact 53% of individual stocks betas. The Chow test results also show that the crisis of 2008 affects less on portfolios compared to individual stocks and, portfolio construction positively influences the stability of the beta in the crisis period. We found the presence of the structural breaks in the beta series. The WD max and UD max results prove that 12 (40%) and 7 (23%) betas have no structural breaks and remaining stocks have the structural break in the series. The above structural breaks of individual stocks adversely impact the beta stability of portfolios. The portfolio-1 and portfolio-2 have one break and Portfolio-3 has 2 breaks. The CUSUM test also proves the results of WD max that all three portfolios beta series are not stable. This result is similar with the results of Deb and Misra (2011). We conclude that all three models prove that 65% stocks have stable beta. This result is consistent with the result of Levy (1971) and Chawla (2001). This result is significant to the market participants to construct the portfolios based on the risk averseness and to form the trading strategies based on the beta stability.

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