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STOCK MARKET DEVELOPMENT IN INDIA : IS THERE ANY TREND BREAK?

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STOCK MARKET DEVELOPMENT IN INDIA: IS THERE ANY TREND BREAK?

Pratap Chandra Biswal* & B Kamaiah* *

Abstract

This paper addresses the important question of what happened to the Indian stock market following financial liberalization. Considering three stock market indicators viz., size, liquidity and volatility, and applying two time series trend break techniques of Perron (1989, 1997) on monthly data (1991:1 to 1998:12) of Bombay Stock Exchange, it has been found that the Indian stock market grew and became more liquid after liberalization. However, in respect of volatility the market had not exhibited any significant changes.

I. Introduction

The role of stock market in the process of development has been well recognized. A developed stock market has been considered crucial to national economic growth as it provides an additional channel (along with banks and other financial institutions) for encouraging and mobilizing domestic savings, and ensures improvements in the productivity of investment through market allocation of capital. The stock market may influence national savings and its allocation and financing decisions of firms before paving the way for economic growth. Taking into account the importance of stock market in the process of economic development, a distinguished international study group (in the late 1980s) for the 'World Institute for Development Economics Research' (WIDER) has argued that the developing countries should liberalize their financial markets in order to attract foreign portfolio equity flows. The study group's essential argument has been that the huge amount of financial capital available in the developed countries could be attracted to the developing countries, provided the latter liberalized their markets externally and developed their stock markets internally.

Keeping pace with the global changes, India has also resorted to financial liberalization, and deregulated the stock market as part of the New Economic Policy (NEP). As a result of this, there has been a phenomenal but

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uneven growth in the stock market. A perusal of the stock market development indicators such as the market capitalization, value traded and turnover ratios reveals this (see tables 1 to 3). In this context, it is of interest to ascertain what happened to stock market development when India followed the policy of financial liberalization. To achieve this objective, it is proposed to examine the stock market development indicators within the framework of trend break analysis as given by Perron (1989, 1997). To address this issue, three measures of stock market development, viz. market size, liquidity and volatility, have been considered and then tested whether these indicators have exhibited any trend breaks over time in response to various national stock markets regulations. The study is confined to the Bombay Stock Exchange (BSE) by considering that it represents the Indian stock market.

To check whether a given series has a smooth or stable growth path or not, it has been the practice to conduct unit root tests. The absence of a unit root in the series confirms stationarity of the series. On the contrary, the presence of a unit root indicates that the given series has become unstable or non-stationary; showing up uneven growth. In the present context of the problem, the stock market has been observed to grow rapidly and unevenly in response to major policy changes that have taken place during the early nineties. Therefore, the use of conventional unit root tests in a routine way may not be an appropriate proposition. Hence, Perron's (1989, 1997) time series trend break techniques have been identified and employed in the present context. The first technique of Perron (1989) assumes that the trend break is exogenously determined, i.e., known beforhand. Given the level of ignorance about the functioning of the stock market, it is more appropriate to apply a unit root test that endogenously determines a trend break (Perron 1997). Since such an attempt has not been made to date in the Indian context, the present study assumes relevance. The organization of the rest of the paper is as follows. Section II describes the stock market development indicators, section III presents a brief note on the trends in stock market development following policy changes, and section IV presents the empirical results of the study, followed by the concluding remarks in section V.

II Stock Market Development Indicators

This study considers four indicators, viz., market capitalization ratio (MCR), value traded ratio (VTR), turnover ratio (TOR) and volatility to reflect stock market development. While MCR is considered as a measure of stock market size, VTR and TOR proxy market liquidity. The fourth measure reflects asset price movement in the stock market, and is to be generated by using an appropriate method.

The MCR is defined as the value of listed shares divided by GDP. Market capitalization is computed using the value of the equity securities only: the stock market price per share is multiplied by the number of shares that are outstanding (that is, by the number of issued shares not held by the company itself). In terms of the economic significance, market capitalization is a proxy for markets size and is expected to be positively related to the ability to mobilize capital and diversify risk. The value traded ratio equals the total value of traded shares in the stock market divided by GDP. The total value traded ratio measures the organized trading of the equities as a share of national output and should therefore positively reflect liquidity on an economy-wide basis. The value traded ratio complements the market capitalization ratios: although a market may be large, there may be little trading. Thus, taken together market capitalization and value traded ratios provide more information about a stock market than each of them in isolation.

A second measure of liquidity is the turnover ratio, which equals the value of total shares traded divided by the market capitalization. High turnover is often used as an indicator of low transaction cost. Turnover also complements total value traded ratio. Although, total value traded ratio captures trading compared to the size of the economy, turnover measures the trading relative to size of the stock market. Put differently, a small, liquid stock market will have a better turnover ratio but a small total value traded ratio. Thus, incorporating information on the total value traded ratio, and turnover ratio provides a more comprehensive picture of liquidity of a stock market.

It may be worthwhile to note here that since financial markets are forward looking, value traded has one potential pitfall. If markets anticipate large corporate profits, stock prices would rise. This price rise would increase the value of the traded shares and therefore raise value traded. Problematically, the liquidity indicator would rise without a rise in the number of the transactions or a fall in transaction cost. This price effect plagues capitalization too. One way to gauge the influence of the price effect is to look at the value traded and capitalization together. The price effect influences both the indicators, but only value traded is directly related to the trading. An alternative way to gauge the importance of price effect is to examine the turnover ratio. The price effect remains neutral to turnover because stock prices enter the numerator as well as denominator of the ratio.

The fourth important measure that is very often used as an indicator of stock market development, as mentioned earlier, is the volatility parameter, which conceptualizes the asset price movement in a stock market. This conveys important signals for its development. In general, it is understood that a less volatile market reflects greater market efficiency and development. However,

greater volatility is not necessarily a sign of a less developed stock market. Indeed, high volatility could be an indicator of development, so far as revelation of information implies volatility in a well-functioning market [Bakert and Harvey (1995)]. Therefore, from the development point of view, an accurate estimation, forecasting, and management of the exposure of the market to high volatility assume greater importance.

In simple terms, volatility of an asset price may be defined as the standard deviation of the asset return over a particular period of time; that is, volatility is measured by the deviation of the absolute returns from the mean returns. For our study purpose we use monthly volatility measure, which is computed as the 12-month rolling standard deviation estimate that is based on market returns [Schwert (1989)]. This involves the following two steps:

Step I. A 12^{th} order autoregression for the returns, including the dummy variable D_{jt} to allow for the different monthly mean returns is estimated as

$$R_t = \sum_{j=1}^{12} \alpha_j D_{jt} + \sum_{i=1}^{12} p_i R_{t-i} + \varepsilon_t \qquad .....(1)$$

Step II. Then a 12th order autoregression for the absolute value of the errors from equation (1) above, including the dummy variables to allow for different monthly standard deviations,

$$|\varepsilon_t| = \sum_{j=1}^{12} \beta_j D_{jt} + \sum_{i=1}^{12} p_i |\varepsilon_{t-1}| + \upsilon_t \qquad .....(2)$$

The regressand of the above equation is an estimate of the standard deviation of the stock market return for month t. The fitted values of this from equation (2) estimate the conditional standard deviation of R_t given information available before month t.

III Trends In Stock Market Development

During the 1980s and 1990s, many developing countries have been engaged in far-reaching reforms of their financial systems, liberalizing them and making them more market oriented. Within the range of financial reforms, the development of stock markets has been quite prominent. The stock markets, in addition to their role in domestic financial liberalization, have also contributed to external financial liberalization in developing countries.

In India, the stock markets remained backward until the 1980s with little scope for expansion in a regime dominated by state-directed credit. The reform of the regulatory framework began in the late 1980s with the establishment of Securities and Exchange Board of India (SEBI), but gained significant momentum with the consolidation of all regulatory authorities with SEBI in 1992. The SEBI has apparently made progress in a number of areas such as; (a) abolition of capital issues control and retaining the sole authority for new capital issues, (b) regulation and reform of the capital market by arming itself with necessary authority and powers, (c) regulating stock exchanges under Securities Contracts Regulation Act (1992-93), (d) bringing all primary and secondary market intermediaries under the regulatory framework, (e) enforcing the companies to disclose all material facts and specific risk factors associated with projects while going in for public issues. Reforms relating to competitive conditions include: (a) free pricing of new issues, (b) allowing foreign institutional investors (FIIs) to have access to stock markets under registration with SEBI, (c) allowing Indian companies to access international markets through GDRs, (d) liberalizing investment norms for NRIs by permitting them to buy shares without RBI permission (Economic Survey, various issues).

As a result of these policy changes, the market capitalization ratio reached a staggeringly high level of 53.3% in 1991-92 in view of the rise in the share prices, which subsequently declined during 1992-93 to 32.4 % due to the decline in the share prices. However, the ratio improved in the next three years and stood at 58.7% in 1995-96 (see Misra 1997). In this regard the 16-country study of Levine and Zervos (1998b) reports that there has been a significant change in market capitalization ratio and value traded ratio in India following capital control liberalization but that at the same time liberalization also tends to increase stock return volatility.

The number of shareholders and investors in mutual funds rose from 2 to 40 million over 1980-93. This makes the Indian investor population the second largest in the world next to US and the largest in terms of companies listed, with nearly 7,985 listed companies by the end of 1995 (see Misra 1997). Besides, the Bombay Stock Exchange is reported to have the highest density of transactions in the world behind only that of Taiwan Stocks Exchange. The daily turnover of shares in BSE increased almost 30-fold during the 1980s and early 1990s from 0.13 billion rupees in 1980-81 to 3.7 billion rupees in 1993-94. The average daily trading volume on the Bombay stock market in the early 1990s was about the same as that in London-about 45,000 trades a day. The number of FIIs, registered with SEBI increased from only 10 in January 1993 to 350 by the end of January 1996. By March 1997, the number increased to 439 (see Misra 1997). Net investment by FIIs, which was only US $4.3 million in 1992-93, suddenly increased to $1634.1 million in 1993-94

and further to $2432.1 million in 1996-97. Then the turbulence in Asian financial markets affected overall FIIs investment in the region to $1649.4 million in 1997-98 (*Economic Survey* 1997-98).

From the above analysis it is evident that the stock market in India has witnessed a phenomenal but uneven growth in the post-liberalization period. It is therefore of interest to trace the changes in the stock market development in the presence of trend breaks, which are employed in the next section.

IV Empirical Analysis

To examine the behaviour of measures of stock market size, liquidity, and volatility before and after financial liberalization, the study begins with an examination of the time series properties of each stock market indicator. If the indicator series is stationary, a simple comparison of means of the series before and after liberalization can be used to gauge the effects of financial liberalization on stock market development. If an indicator is trending upward, then no matter where the event date lies, the data will show that stock market development subsequently rose.

A trending series suggests the possibility of a unit root, which would make a t-test comparison of pre-and-post-liberalization means invalid. Traditional tests for unit roots, however, frequently do not reject the hypothesis of a unit root even when the series is stationary. In addition, Perron (1989) shows how standard tests of the unit root hypothesis against trend stationary alternatives cannot reject the unit root hypothesis if the true data generating mechanism is that of stationary fluctuations around a trend function that contains a one-time break. In the present case, the inability to reject the hypothesis of a unit root may instead imply the existence of a one-time break in the series at the liberalization policy event date.

The present study begins with testing for a unit root using Dicky-Fuller (DF), Augmented Dicky Fuller (ADF) and Phillips-Perron (PP) tests, allowing for two variations: one without trend, and another with trend, and use the significance tables provided by Dickey-Fuller (1979). Using a p-value at 0.05, the study evaluates the null hypothesis of a unit root. If the null hypothesis is rejected, the simple t-test comparison of means for each indicator before and after liberalization, may be used. If the null hypothesis cannot be rejected, a meaningful alternative the study uses is the technique of Perron [1989, (see Appendix B)] to test for a trend break in the series. Finally, if there is an evidence of a unit root, and no evidence of a trend break in the series, the test is inconclusive to make a statistical conclusion regarding the effect of the policy on the stock market development indicator.

The major assumption of Perron (1989) method is that the break date is to be fixed (exogenous) and chosen independently of data. This assumption has drawn much criticism in subsequent papers, based on the argument that break dates are often chosen after looking at the data. [Christiano (1992), Banerjee et al., (1982), Perron (1997)]. The strategy used in all the above studies was to endogenize the choice of break date by making it data dependent. In this regard, the technique developed by Perron [1997, (see Appendix C)], which allows a shift in trend at an unknown time irrespective of the policy event date, is considered more relevant.

Here, the empirical investigation starts with the analysis of stock market development indicators series provided in tables 1 to 4. For the entire period of the study the stock market, as shown by the four indices, recorded higher growth in the case of market capitalization ratio and value traded ratio. As a measure of market size, the market capitalization ratio increased from 138.57 in 1991:1 to 599.87 in 1998:12. The average of the market capitalization ratio for the entire period is 516.02, whereas the average ratio before the policy event date* (period 1) is 317.05 and after, it increased to 586.07. The study also shows that the series is an upward trending one, which started to rise from the middle of 1992, declined a little during the later part of 1992 and ultimately continued to increase from the middle of the year 1993. Value traded ratio, the second development indicator which acts as a measure of liquidity of the stock market, increased from 6.35 in January 1989 to 80.36 in December 1998 and showed a higher increase during 1997û98. The average of the value traded ratio for the entire sample period is 26.64, whereas it stood at 10.92 and 34.12 in period 1 and period 2 respectively. The third indicator of the stock market development is the turnover ratio, which complements the value traded ratio in measuring the stock market liquidity, increased over the sample period from 0.01056 in January 1991 to 0.13396 in December 1998. The mean value of the series over the whole period is 0.05, and there is very little difference between the mean values before and after the policy event date. Analysis of the value traded ratio and the turnover ratio reveals that the Indian stock market is more liquid in relation to the growth of the economy than the growth of the market size. Volatility is the fourth indicator of the stock market development, which shows a constant trend over the entire sample period. From the analysis of the mean it can be said that it showed hardly any decline in period 2 than in period 1.

The empirical investigation for measuring the trend break starts with the unit root test to examine the time series property of the concerned indicator

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* The policy event date is chosen to be January 1993. The period between January 1991 and December 1992 is considered as period 1 and thereafter period 2.

series. The indicator variables considered are market capitalization ratio, value trade ratio, turnover ratio, and monthly volatility. Using p-values of 0.05 and 0.10, market capitalization ratio, value traded ratio and turnover ratio series do not reject the null hypothesis of a unit root, and hence are non-stationary. Only volatility series rejects the null hypothesis of a unit root, indicating that the series is stationary. Consequently, for the monthly volatility series, a simple mean comparison before and after policy event date is made to gauge the effect of policy changes on the series and a t- test to detect if there has been any significant change in the period 2. The result shows that the average of the monthly volatility series is 0.055413 and 0.050962 before and after the policy event date respectively. Though the average volatility after the policy event date is smaller, the difference is not significant. Thus the results of the tûtest show that the volatility series is not exhibiting any significant change after the policy change.

In the case of the three indicator series which were found to be non-stationary, the usual t- test becomes invalid. Hence to detect a one time trend break, the Perron (1989) model [Appendix B] has been employed. This technique performs a unit root test of a given series in the presence of an exogenously given trend break point. Since most of the liberalization measures in India were undertaken in 1992-93, the present study takes January 1993 as the break period. The market capitalization ratio series displays a significant change after the policy event date (defined by the significance of the dummy variables coefficients given in Table 6. The results provided in Table 6 show that there is no significant change either in level or growth rate of series or both level and growth, which implies there is no one time break in series. These results are obtained from the coefficients of the dummy variables, DTB, DTS and DT, which are not significantly different from zero.

The trend break results for value traded ratio series (shown in Table 7) reveal that there is no significant shift in the level of the series as indicated by DTB coefficient which is not significantly different from zero. However, one time break is observed for the growth rate of the series as exhibited by coefficients of DTS and DT.

It has been found from Table 8 that there is no exogenous change in the level of the turnover ratio. At the same time, a significant improvement in the series after the event date permits an exogenous change in the growth rate of the series. One time trend break or significant improvement after the policy event date in case of the turnover ratio, is evidenced from the significant non-zero coefficients given in Table 8.

The application of the Perron (1997) test is more reasonable in the sense that a break is viewed as occurring more gradually over time rather than

as a sudden occurence. For the market capitalization series, the coefficients of dummy variables are not significantly different from zero, and hence it does not report any change in the series at the endogenous break point observed in September 1993 (Table-9). However, in the case of value traded ratio, both the coefficients of dummy variables, DU and DT, are significantly different from zero, reporting December 1995 as the endogenous break point in the series. It implies that there is a break at this point of time both in level as well as growth rate of the series. Similar results are obtained in the case of turnover ratio reporting an endogenous break in both level and growth rate in August 1995. Thus, the results of these three indicators conclude that, though policy break date happens to be January 1993, the indicator series exhibit gradual changes over time in the post- liberalization period.

V Concluding Remarks

This paper evaluates the behaviour of stock market development indicators, namely, market size, liquidity, and volatility, and examines whether these indicators have exhibited any trend changes after India liberalized its financial policies. The findings of the study suggest that stock market becomes larger and more liquid in the post-liberalization period. In respect of volatility, however, the market does not exhibit any significant change. This analysis also looks into the time series properties of stock market size, liquidity and volatility following liberalization measures in India. The finding that stock market liquidity tends to rise following liberalization assumes importance, since it is a robust predictor of long-run per capita GDP growth (Levine and Zervos, 1998a). The findings of the study are in line with the findings of the 16-country study of Levine and Zervos (1998b), which reported a significant change in liquidity and market size after liberalization. However, in the case of volatility, the results differ from those of Levine and Zervos (1998b), who found that volatility increased; and Demirguc-Kunt and Levine (1996), who maintained that volatility decreased after liberalization. The evidence of the present study, on the whole, reveals that stock market in India has experienced phenomenal growth in the 90s when compared with the 80s.

Table 1
Market Capitalization Ratio (MCR)

Month	MCR	Month	MCR	Month	MCR
1991:1	138.57	9	443.46	5	545.05
2	173.52	10	437.22	6	571.48
3	136.29	11	518.57	7	524.87
4	206.02	12	489.86	8	506.56
5	210.93	1994:1	605.06	9	471.97
6	202.89	2	667.15	10	660.89
7	247.06	3	519.65	11	613.69
8	278.77	4	654.21	12	601.79
9	278.70	5	662.48	1997:1	660.89
10	271.96	6	678.88	2	711.86
11	277.39	7	678.77	3	608.17
12	255.39	8	732.47	4	748.20
1992:1	286.69	9	689.62	5	734.75
2	341.17	10	676.70	6	848.48
3	414.66	11	650.74	7	871.38
4	522.49	12	578.94	8	801.39
5	429.88	1995:1	547.8	9	788.30
6	424.29	2	539.94	10	771.90
7	400.01	3	465.29	11	686.65
8	443.07	4	521.25	12	691.99
9	456.81	5	525.93	1998:1	613.86
10	418.67	6	532.94	2	603.60
11	374.77	7	546.19	3	731.39
12	361.76	8	523.49	4	837.04
1993:1	374.62	9	524.73	5	772.25
2	383.3	10	522.21	6	687.17
3	273.69	11	443.86	7	674.67
4	343.31	12	432.57	8	619.96
5	357.73	1996:1	402.48	9	655.00
6	362.20	2	477.03	10	607.97
7	373.70	3	429.58	11	578.59
8	419.00	4	567.69	12	599.87

Table 2
Value Traded Ratio (VTR)

Month	VTR	Month	VTR	Month	VTR
1989:1	6.35	5	14.94	9	17.94
2	7.29	6	4.35	10	16.61
3	7.71	7	2.56	11	14.01
4	9.09	8	10.24	12	12.43
5	6.36	9	18.86	1996:1	13.93
6	7.11	10	11.97	2	21.93
7	8.42	11	8.89	3	11.89
8	9.22	12	5.18	4	24.65
9	9.92	1993:1	6.16	5	31.09
10	9.23	2	15.78	6	41.61
11	6.33	3	7.69	7	51.12
12	7.71	4	9.83	8	25.65
1990:1	9.72	5	13.08	9	21.25
2	5.68	6	16.19	10	29.25
3	7.59	7	11.16	11	22.19
4	9.69	8	29.66	12	18.64
5	13.06	9	19.12	1997:1	49.97
6	13.85	10	16.13	2	40.06
7	14.43	11	29.49	3	47.71
8	10.39	12	17.04	4	39.86
9	8.81	1994:1	43.11	5	37.28
10	8.81	2	38.26	6	60.22
11	10.24	3	18.33	7	69.16
12	7.13	4	14.99	8	62.64
1991:1	1.46	5	14.85	9	60.92
2	3.61	6	27.22	10	54.22
3	4.11	7	22.54	11	47.81
4	13.39	8	28.44	12	54.19
5	11.35	9	27.65	1998:1	51.86
6	14.97	10	24.14	2	50.17
7	23.87	11	19.73	3	68.16
8	20.47	12	14.12	4	86.13
9	15.96	1995:1	14.69	5	74.69
10	17.41	2	12.68	6	73.47
11	18.98	3	9.11	7	68.65
12	15.19	4	6.83	8	58.95
1992:1	28.09	5	10.39	9	89.82
2	16.43	6	17.89	10	73.76
3	15.61	7	19.11	11	64.48
4	16.67	8	14.21	12	80.36

Table 3
Turnover Ratio (TOR)

Month	TOR	Month	TOR	Month	TOR
1991:1	0.01056	9	0.04313	5	0.05706
2	0.02077	10	0.03691	6	0.07295
3	0.03667	11	0.05679	7	0.09741
4	0.06511	12	0.03479	8	0.05065
5	0.05378	1994:1	0.07124	9	0.04504
6	0.07381	2	0.05735	10	0.04427
7	0.09662	3	0.03528	11	0.03616
8	0.07343	4	0.02291	12	0.03099
9	0.05731	5	0.02242	1997:1	0.07561
10	0.06402	6	0.04009	2	0.05685
11	0.06843	7	0.03322	3	0.07845
12	0.05945	8	0.03883	4	0.05328
1992:1	0.09799	9	0.04009	5	0.05074
2	0.04817	10	0.03564	6	0.07098
3	0.03762	11	0.03033	7	0.07937
4	0.03191	12	0.02438	8	0.07817
5	0.03474	1995:1	0.02681	9	0.07728
6	0.01026	2	0.02352	10	0.07025
7	0.00641	3	0.01957	11	0.06862
8	0.02311	4	0.01311	12	0.07832
9	0.04128	5	0.01962	1998:1	0.08449
10	0.02859	6	0.03349	2	0.07131
11	0.02372	7	0.03486	3	0.09321
12	0.01432	8	0.02713	4	0.10291
1993:1	0.01644	9	0.03419	5	0.09673
2	0.04117	10	0.03179	6	0.10691
3	0.02812	11	0.03158	7	0.10176
4	0.02866	12	0.02877	8	0.09509
5	0.03657	1996:1	0.03462	9	0.13713
6	0.04456	2	0.04597	10	0.12133
7	0.02987	3	0.02769	11	0.11004
8	0.07079	4	0.04434	12	0.13396

Table 4
Monthly Volatility (MVT) Series

Month	MVT	Month	MVT	Month	MVT	Month	MVT
1985:1	0.017051	7	0.060356	1992:1	0.030403	7	0.035609
2	0.018050	8	0.064518	2	0.113808	8	0.006942
3	0.034507	9	0.011596	3	0.282862	9	0.013245
4	0.036551	10	0.055777	4	0.017957	10	0.048728
5	0.050198	11	0.026435	5	0.205026	11	0.090378
6	0.088099	12	0.058791	6	0.006401	12	0.003207
7	0.061997	1989:1	0.011675	7	0.110562	1996:1	0.047498
8	0.029930	2	0.011307	8	0.002774	2	0.091363
9	0.077750	3	0.016274	9	0.112791	3	0.087332
10	0.047506	4	0.027449	10	0.115704	4	0.051982
11	0.033897	5	0.033776	11	0.050416	5	0.034653
12	0.059795	6	0.050334	12	0.018240	6	0.002000
1986:1	0.047242	7	0.004360	1993:1	0.030589	7	0.079085
2	0.050281	8	0.094443	2	0.014516	8	0.059796
3	0.122109	9	0.018169	3	0.125635	9	0.019538
4	0.041053	10	0.014844	4	0.004980	10	0.052422
5	0.003385	11	0.010236	5	0.048014	11	0.003908
6	0.012290	12	0.071898	6	0.062999	12	0.033291
7	0.042241	1990:1	0.074935	7	0.066079	1997:1	0.117517
8	0.083809	2	0.104147	8	0.132708	2	0.043020

Month	MVT	Month	MVT	Month	MVT	Month	MVT
9	0.016878	3	0.064111	9	0.012837	3	0.065638
10	0.009670	4	0.035892	10	0.004952	4	0.067942
11	0.084588	5	0.017414	11	0.082765	5	0.042497
12	0.027456	6	0.004104	12	0.116820	6	0.050573
1987:1	0.060172	7	0.162041	1994:1	0.053242	7	0.004603
2	0.002007	8	0.081173	2	0.007633	8	0.040347
3	0.110302	9	0.077371	3	0.073990	9	0.088024
4	0.039375	10	0.018001	4	0.029830	10	0.045428
5	0.058608	11	0.006528	5	0.017056	11	0.076765
6	0.054756	12	0.090051	6	0.069382	12	0.035796
7	0.082300	1991:1	0.137698	7	0.084492	1998:1	0.007434
8	0.054038	2	0.088446	8	0.078091	2	0.068562
9	0.067379	3	0.011752	9	0.006449	3	0.144108
10	0.028089	4	0.002818	10	0.045234	4	0.033033
11	0.026269	5	0.061690	11	0.002812	5	0.044222
12	0.024006	6	0.047885	12	0.030979	6	0.156010
1988:1	0.057356	7	0.119341	1995:1	0.070972	7	0.043783
2	0.122519	8	0.111405	2	0.036547	8	0.115247
3	0.011491	9	0.006070	3	0.032342	9	0.003775
4	0.015674	10	0.000951	4	0.054215	10	0.058684
5	0.174653	11	0.112863	5	0.038989	11	0.062029
6	0.015477	12	0.034605	6	0.048001	12	0.010103

Table 5
Unit Root Test Statistics on Indicator Series

Indicators	Without Trend			With Trend		
	DF	ADF	PP	DF	ADF	PP
MCR	-2.42	-2.15(4)	-2.34(4)	-2.96	-2.48(4)	-2.92(4)
VTR	-1.67	0.34(4)	-0.82(4)	-3.58	-1.27(4)	-3.18(4)
TOR	-2.52	-0.38(4)	-2.17(4)	-3.18	-1.26(4)	-2.99(4)
MVT	-13.88	-5.39(4)	-13.95(4)	-13.85	-5.38(4)	-13.92(4)

Note: MCR, VTR, TOR, and MVT denote monthly Market Capitalization Ratio, Value Traded Ratio, Turnover Ratio and Volatility respectively.

Table 6
Perron (1989) Trend Break Test For Market Capitalization Ratio

Models	Constant	DMU	TREND	DTB	DTS	DT
A	17.93 (2.08)	6.13 (0.71)	0.09 (0.47)	-6.75 (-0.28)		
B	12.78 (0.87)	2.63 (0.23)	0.43 (0.52)		-0.34 (-0.41)	
C	12.82 (0.86)	11.92 (0.73)	0.44 (0.52)	-7.11 (-0.29)		-0.36 (-0.42)

Note: figures in parentheses represent respective t-ratios

Table 7
Perron (1989) Trend Break Test For Value Trade Ratio

Models	Constant	DMU	Trend	DTB	DTS	DT
A	-2.05 (-1.20)	-4.74 (-1.45)	0.18 (3.01)	8.62 (0.99)		
B	2.97 (1.16)	-3.04 (-0.95)	0.02 (0.27)		0.27 (4.48)	
C	2.98 (1.17)	-17.75 (-2.97)	0.02 (0.27)	10.84 (1.28)		0.29 (2.60)

Note: figures in parentheses represent respective t-ratios

Table 8 Perron (1989)
Trend Break Test For Turnover Ratio

Models	Constant	DMU	Trend	DTB	DTS	DT
A	0.008 (1.88)	-0.01 (-1.63)	0.0003 (2.50)	0.02 (1.42)		
B	0.03 (3.75)	0.003 (0.43)	-0.001 (-2.49)		0.002 (3.14)	
C	0.03 (3.77)	-0.04 (-3.62)	-0.001 (-2.51)	0.02 (1.60)		0.002 (3.22)

Note: figures in parentheses represent respective t-ratios

Table 9
Perron (1997) Endogenous Trend
Break Test For Indicator Series

Indicator	Constant	DU	D(Tb)	Time	DT
MCR	146.21 (4.09)	-46.67 (-0.64)	76.48 (1.19)	6.67 (3.94)	-1.23 (-1.14)
VTR	3.29 (1.35)	-84.72 (-4.24)	6.38 (0.75)	0.17 (2.62)	0.96 (4.32)
TOR	0.03 (3.75)	-0.05 (-3.92)	0.03 (1.93)	-0.0005 (-1.80)	0.001 (3.37)

Note: figures in parentheses represent respective t-ratios

Appendix A

The study makes use of monthly data collected from the different issues of the Stock Exchange Review published by BSE, Mumbai. However, the starting period has been selected taking into account the availability of data. Data for market capitalization and turnover ratio range from 1991:1 through 1998:12 while that for the value traded spans from 1989:1 through 1998:12. Required price data to construct volatility series has been collected as the average monthly value of BSE Sensitive Index for the period 1983:12 through 1998:12. For the estimation of market capitalization ratio and value traded ratio, the Index of Industrial Production (IIP) has been used as a proxy for the GDP as the latter is not available on monthly basis. IIP data have been collected for the period 1989:1 to 1998:12 from different issues of Reserve Bank of India Bulletin. Since most of the liberalization measures were undertaken in 1991 and 1992, the present study is justified taking January 1993 as the break period.

Appendix B

Perron (1989) technique performs a unit root test of a given series in the presence of an exogenously given trend break. It considers three models, where the first allows for an exogenous change in the level of the series; the second permits an exogenous change in the growth rate of the series and the third permits both. For a given series say, yt, these models may be specified as follows:

$$\text{Model A: } y_t = c + \theta\, DMU_t + \alpha\ TREND + \beta\, DTB_t + u_t$$

$$\text{Model B: } y_t = c + \theta\, DMU_t + \alpha\ TREND + y\, DTS_t + u_t$$

$$\text{Model C: } y_t = c + \theta^*\, DMU_t^* + \alpha\, TREND + \delta DT_t + \beta DTB_t + u_t$$

where c is a constant θ, θ^*, α , y, δ, and β are parameters, u_ts are the error terms and DTB_t, DMU_t, DTS_t, DMU_t^* and DT_t are dummy variables, which are defined as follows:

$DTB = 1$ if $t = TB+1$ (TB is time break), 0 otherwise.

$DMU_t = 1$ if $t > TB$, 0 otherwise.

$DTS_t = t\text{-}TB$ if $t > TB$, 0 otherwise.

$DT_t = t$ if $t > TB$ and $DMU_t^* = 1$ if $t > TB$, DT otherwise

Presence of a trend break in the series is confirmed by the test of significance of the dummy variables.

Appendix C

In contrast with Perron (1989), Perron (1997) technique conducts a unit root test of a given series when the break period is endogenously determined. It considers the following model and allows a change in both intercept and slope. The model is given by

$$y_t = c + \alpha\ t + \beta D(Tb)_t + y\, DU_t + \theta\, DT_t + u_t$$

where c is a constant, α , β, g, and θ are parameters, ut is an error term, t is linear trend , Tb is endogenous time break, and DU_t, $D(Tb)_t$ and DT_t are the dummy variables which are defined as follows:

$DU_t = 1$ if $t > Tb$, $DT_t = t$ if $t > Tb$

$D(Tb)_t = 1(t = Tb+1)$.

Presence of trend break in the series is confirmed by the test of significance of the dummy variables.

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