

FINANCIAL FRAGILITY IN INDIAN STOCK MARKETS : THE DECADE OF THE NINETIES
- A TIME SERIES STUDY

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ABSTRACT

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The decade of the nineties (particularly since 1991) witnessed major deliberate policies, bearing on almost all sectors & segments of the Indian economy, aimed at reforming radically the functioning of the economy. Furthermore, the policymakers are affirming their commitment to the same with renewed vigor, even to the extent of phased follow-up of second generation reforms targeting, among others, particularly, the financial sector. It is time, therefore that we take a look at the impact of these reform measures in making the financial system stable, resilient i.e. solid or fragile.

We have long been aware of the beneficial impact of a well functioning financial infrastructure on the real sector of the economy. Conversely, the economic turmoil in the recent East Asia crisis have once again brought into sharp focus the key role of financial fragility in aggravating crises through the banking, currency and securities markets in particular, hampering investor confidence operating in such markets and thus seriously impeding the ability of securities markets in performing the intermediary role between the savers and investors.

Given the intertwined financial and real sectors, the conduct of proper macroeconomic management and attainment of macro-objectives is dependent in a large measure on the health – in respect of both width and depth – of the financial system as well. The lack of this or financial fragility has been identified as a major source in the periodic crises within the last couple of decades and the recent East Asian Crisis in 1997 with problems in the banking sector, deepening of the currency crisis and an almost meltdown in the stock markets, with one setting the crisis in motion and the other exacerbating the others.

Our study (Sarkar, et.al, 2001) delves into a detailed empirical analysis of the stock markets, in particular, looking into the existence of (larger than normal) deviations and their persistence over time, i.e., presence of asset bubbles, and as such presents findings on extent of financial fragility or the lack of it in the stock markets. In order to investigate the extent to which the stock markets are linked to the fundamental variables, we look at (1) an assortment of basic financial/real variables, e.g., net worth per share (book value per share), profit per share (EPS), dividend per share and debt-equity ratio; (2) dynamic variables, like rate of growth of net worth per share, profit per share, dividend per share and debt-equity ratio as surrogates for expectations; and (3) macroeconomic policy variable, like prime lending rate. We (Sarkar et. al, 2001) have attempted both cross-section and time-series analyses on (1) and (2) and a time-series analysis on (3).

The time-series study is discussed in sections on introduction, the dataset, the model, analysis of the results of goodness-of-fit, analysis of the results of volatility and finally, the conclusion.

The time-series study in respect to the stock market, reveals that the structure of these markets in India is best described by the presence of historical real (net worth per share, profitability per share) and financial (debt-equity ratio, dividend distributed per share) variables as well as their rationally expected growth values over the future. This structure is cointegrated with the stock price so that it may be said that in corporate governance, price is an important consideration in making decisions on the above explanatory variables at the corporate level. This is in the light of the fact that although there is a lot of residual volatility, lack of explosive components makes cointegration possible. If one compares it with the fact that the relationships within the model are stronger in the annual data in periods distant from 1993 and 1997, the two periods of crashes and other significant events, as discussed in the beginning (which therefore opens up areas of further analysis of structural breaks), then the linear fit, on average, suggests that in spite of a high degree of volatility, "planned competition" has been responsible in preventing markets from

crashing more often, and changing the overall structure of the interplay between price formation, history and expectations along with it.

INTRODUCTION

A major plank in a non-fragile financial infrastructure is obviously a stock market performing in the best possible manner. Optimal stock market operations imply among others stock prices moving in accordance with fundamentals which simultaneously ensure optimal returns (i.e. risk free rate plus premium for risk borne) for investors and raising required capital at optimal cost for borrowing firms. At any given point in time or during any given period of time, stock price will move in an attempt to find levels commensurate with fundamental explanatory variables. The fundamental explanatory variables include financial as well as economic variables, which determine the value of a stock. Thus, the deviation between actual market price and fundamentally explained price of a stock should be random. Conversely, the larger than normal deviations, deviations not petering out quickly – i.e., non-random behavior, points to existence of and building up of bubbles (with possibilities of boom and subsequent bust) leading to financial fragility.

Fama's (1970) early original work indicated that stock prices moved according to fundamentals. However, empirical researches since then have raised serious doubts about this observation. Shiller (1981) found stock prices to be more volatile than what would be warranted by economic events. Blanchard and Watson (1982) show that when the bubble is present, the proportional change in stock prices is an increasing function of time and therefore predictable; further, as time increases, the bubble starts dominating fundamentals, which can be tested by regressing the proportional change in stock prices on time. Summers (1986) opined that financial markets were not efficient in the sense of rationally reflecting fundamentals. Fama and French (1988) in their paper on permanent and temporary components of stock prices found returns to possess large predictable components casting doubts about the efficiency of the stock market. Dwyer and

Hafer (1990) examined the behavior of stock prices in a cross-section of countries and found no support for either 'bubbles' in or the fundamentals in explaining the stock prices. Froot and Obstfeld (1991) study on 'Intrinsic Bubbles – the Case of Stock Prices' once again doubts about the stock prices being determined by the fundamentals.

For Indian stock markets, there have been a number of studies on the question of efficiency. Studies by Barua (1981), Sharma (1983), Gupta (1985) and others indicate weak form of market efficiency. For example, Sharma (1983) uses data of 23 stocks listed in the BSE between the period 1973-78 and his results indicate at least weak form of random walk holding for the BSE during the period. There were also tests by Dixit (1986) and others, which primarily regress stock prices on dividends to test the role of fundamentals. These tests also found support for efficiency hypothesis. However, evidence in the recent period, particularly in the 1990's, Barua and Raghunathan (1990), Sundaram (1991), Obaidullah (1991) raise doubt about this hypothesis. For example, Barua and Raghunathan (1990) used (BSE) 23 leading company stock prices. They estimated P/E ratio based on fundamentals and compared them with actual P/E data. The result indicated shares to be over- valued. Obaidullah (1991) used sensex data from 1979-1991 and found that stock price adjustment to release of relevant information (fundamentals) is not in the right direction, implying presence of undervalued and overvalued stocks in the market. Barman and Madhusoodan (1993) in their RBI Papers found that stock returns do not exhibit efficiency in the shorter or medium term, though appear to be efficient over a longer run period. Barman (1999) study finds that fundamentals rather than bubbles are more important in the determination of stock prices in the long run; however, discerns contribution of bubbles, mild though it is, in stock prices in the short run.

Besides, it is the 90s which has seen significant structural changes with the opening up of the financial markets through privatising a large part of the public sector and the opening of the national stock exchange with the introduction of online trading. The purpose of this study is to bring out the long run properties of the Indian stock market by relating a) the relation of stock

prices to fundamentals and b) by estimating the extent to which bubbles are present in the stock market data. It is to be emphasized that this study differs from other studies from another direction. This study analyses the properties of the stock prices as opposed to returns in the section on cross-sectional analysis. Since financial capital is to a large extent independent of the political structure of the firm, cross-sectional analysis can estimate the stationary properties of stock prices at least around that date. In the other section on time series analysis, we analyse price differentials over various time periods.

DATASET SOURCE

Data for the regression estimates is obtained from the Prowess database of Centre for Monitoring Indian Economy. It is a pooled database covering the period 1988-2001. Prowess provides information on around 7638 companies. The coverage includes public, private, co-operative and joint sector companies, listed or otherwise. These account for more than seventy per cent of the economic activity in the organised industrial sector of India. It contains a highly normalised database built on disclosures in India on over 7638 companies. These data has been compiled from the audited annual accounts of all public limited companies in India which furnish annual returns with Registrar of Companies and are listed on the Bombay Stock Exchange. The database provides financial statements, ratio analysis, funds flows, product profiles, returns and risks on the stock markets, etc. Besides, it provides information from scores of other reliable sources, such as the stock exchanges, associations, etc.

In estimating the Time Series properties of Price formation in stock markets, the historical data can be divided into instantaneous, short-run, medium-run and long-run. Instantaneous analysis requires data generated in continuous time for all variables whether relating to price formation or fundamentals. This study however, uses discrete time data organised annually into a decade.

Hence, this study is both a short-run, as well as, a medium-run study of the stock market system.

Long-run analysis of stock market data however, requires analysis of historical epochs, which in a semi-planned economy such as India ought to cover more than two consecutive plan periods.

This study covers a segment of the 7th Five Year Plan Period, the 8th Five Year Plan Period in full

and the first portion of the 9th Five Year Plan Period. This period also witnessed two significant stock market crashes in the years 1993 and 1997 and the “Harshad Mehta scam” in 1992. The time series results have to be analysed against these sets of contemporary history along with the economic causalities outlined in the model (Bagchi(1998)).

TIME SERIES DATASET

Data for the time series regression are obtained from the Prowess database of the centre for Monitoring Indian Economy. The database contains data for the years 1988-2000. The data have been compiled from the audited annual accounts of public limited companies in India which furnish Annual Returns with the Registrar of Companies and are listed on the Bombay Stock Exchange.

In our time series analysis we have used annual series of all the variables, described below, for the period 2000-1990. While higher frequency series for some of the variables are available, since matching series for all the variables are not contained in the database, we have analysed data for years ending 31st December for all variables.

“Average Growth” Data

The total market set of companies has been pooled for 10 years from 2000-1990, working backwards. The common set of firms which have “survived” between 1990-2000 (see Chapter III) number 582 which after adjusting for missing data is left with 573 firms. This is the “bootstrap” average growth data set. The graphs for the raw variables are presented in figure 2.2.1.1. to 2.2.1.9 in the Appendix and are available on request.)

Annual Price Differential Data

One period annual price differential (Return) datasets for the annual growth models 2000 –1999 to 1991-1990 are presented in the form of correlation matrix in table 2.2.2.1. A casual look at the correlation gives an approximate idea of the nature of relationship existing between the various variables over the annual partitions of the 10-year period.

Table 2.2.2.1

	RET_1Y	RET_2Y	RET_3Y	RET_4Y	RET_5Y	RET_6Y	RET_7Y	RET_8Y	RET_9Y	RET_10Y
RET_1Y	1.00	-.04	.00	.02	-.01	-.01	.01	.00	.01	.00
RET_2Y	-.04	1.00	-.05	.01	.01	.02	-.00	-.01	-.01	-.03
RET_3Y	.00	-.05	1.00	.03	-.02	-.01	.02	.05	.02	-.01
RET_4Y	.02	.01	.03	1.00	.01	-.02	.01	.01	-.01	-.04
RET_5Y	-.01	.01	-.02	.01	1.00	-.03	.00	-.02	.00	.05
RET_6Y	-.01	.02	.01	-.02	-.03	1.00	.02	.02	.04	.01
RET_7Y	.01	-.00	.02	.01	.00	.02	1.00	-.00	-.01	-.01
RET_8Y	.00	-.01	.05	.01	-.02	.02	-.00	1.00	-.03	-.01
RET_9Y	.01	-.01	.02	-.01	.00	.04	-.01	-.03	1.00	-.01
RET_10Y	.00	-.03	-.01	-.04	.05	.01	-.01	-.01	-.01	1.00

No correlations are significant at $p < .05000$

Manufacturing Sector Data

The only industry that has been considered in isolation from the market dataset is the manufacturing sector. The reason being that the only sector that has a large number of surviving firms between 1990 & 2000 is this sector. Three stages in the algorithm are carried out with respect to this dataset. The 2000 – 1990 average growth model is fitted as also the 2000 – 1999 annual growth model is fitted. The fits, as well as the errors, are then compared to ensure that the errors are uncorrelated. The total number of firms in the first data set is 517 and in the other case is 1925. The correlation matrices with respect to the two growth models are given in tables 2.2.3.1 and 2.2.3.2.

Table 2.2.3.1

	NW_SH90	DE_SH90	PT_SH90	DIV_SH90	GNW_S10Y	GDE_S10Y	GPT_S10Y	GDV_S10Y	RET10Y
NW_SH90	1.000000	.025183	.740111	.851955	.114692	-.032914	-.100677	-.429485	.210495
DE_SH90	.025183	1.000000	.018750	.010412	.019033	-.777652	.012947	.008249	.014449
PT_SH90	.740111	.018750	1.000000	.706037	.139353	-.038373	-.218449	-.450747	.071874
DIV_SH90	.851955	.010412	.706037	1.000000	-.113054	-.009213	-.306639	-.658594	.062606
GNW_S10Y	.114692	.019033	.139353	-.113054	1.000000	-.008633	.881516	.413916	.355693
GDE_S10Y	-.032914	-.777652	-.038373	-.009213	-.008633	1.000000	.006541	-.015088	-.016135
GPT_S10Y	-.100677	.012947	-.218449	-.306639	.881516	.006541	1.000000	.463758	.339531
GDV_S10Y	-.429485	.008249	-.450747	-.658594	.413916	-.015088	.463758	1.000000	.439172
RET10Y	.210495	.014449	.071874	.062606	.355693	-.016135	.339531	.439172	1.000000

Table 2.2.3.2

	NW_SH99	DE_SH99	PT_SH99	DIV_SH99	GNW_S1Y	GDE_S1Y	GPT_S1Y	GDV_S1Y	RET_1Y
NW_SH99	1.000000	.006132	.732348	.440819	.618084	-.000103	.285385	-.010703	-.212520
DE_SH99	.006132	1.000000	.014161	-.001055	.012673	-.339267	.004004	.000673	.003175
PT_SH99	.732348	.014161	1.000000	.289349	.526261	-.008514	-.206490	-.017957	-.157580
DIV_SH99	.440819	-.001055	.289349	1.000000	.035746	-.001292	-.072465	-.565834	-.382219
GNW_S1Y	.618084	.012673	.526261	.035746	1.000000	-.007056	.427272	.287532	-.107605
GDE_S1Y	-.000103	-.339267	-.008514	-.001292	-.007056	1.000000	-.002271	-.000435	.001055
GPT_S1Y	.285385	.004004	-.206490	-.072465	.427272	-.002271	1.000000	.163399	.063614

GDV_S1Y	-.010703	.000673	-.017957	-.565834	.287532	-.000435	.163399	1.000000	-.019667
RET_1Y	-.212520	.003175	-.157580	-.382219	-.107605	.001055	.063614	-.019667	1.000000

TIME SERIES MODEL

We consider the following time series model for dynamic price formation in Indian stock markets.

$$P_{t+1} - P_t = A_t + B_{1t} NW_t + B_{2t} DE_t + B_{3t} PT_t + B_{4t} DIV_t + B_{5t} E_t ? NW_t + B_{6t} E_t ? DE_t + B_{7t} E_t ? PT_t + B_{8t} E_t ? DIV_t + \mathbf{h}_t, \mathbf{h}_t \sim N(0, S_t^2)$$

where, P_t = closing price of shares at 31st December of the year t,

NW_t = Net worth per outstanding equity share at 31st December of the year t,

PT_t = Profit for the year t per outstanding equity share at 31st December of the year t,

DE_t = Debt Equity ratio at 31st December of the year t,

DIV_t = Dividend declared during year t per outstanding equity share at 31st December of the year t

? $NW_t = NW_{t+1} - NW_t$, is the first forward difference in NW,

? $PT_t = PT_{t+1} - PT_t$, is the first forward difference in PT,

? $DE_t = DE_{t+1} - DE_t$, is the first forward difference in DE,

? $DIV_t = DIV_{t+1} - DIV_t$ is the first forward difference in DIV

E_t is the forward looking Rational Expectations operator with respect to 31st December of year t.

η_t is a random error term normally distributed with mean 0 and variance matrix $S_t^2 > 0$

We shall jointly test for the fit of the model as well as the properties of the error terms hypothesized, with annual data over the period 1990-2000.

The econometric testing of a time series model of this form, which consists of a large cross-section of companies at any given t, can be carried out along two directions. The first method is the traditional Vector Auto Regression method of the Box-Jenkins type. In such a method the

entire panel data pooled across firms and time periods has to be studied in integrated form to give GLS estimates by the ARIMA model. This has the potential dimensionality cost of there being

around 2500 firms for each of the years 1990 –2000 with twelve variables, which could become a 2500 X 10 X 12 matrix requiring high computing time and memory costs. Besides, with a linear model specification such as ours the nonlinearity involved in the historical behavior of stock prices would not be readily evident till we change our specification and fit a nonlinear model all over again. This prompts us to carry out the Time-Series GLS regression in a “ nested” procedure similar in many respects with that suggested by Granger & Newbold (1977) and consists of the following algorithm. This algorithm uses the residual matrix of nested models to set up an objective function based on correlations amongst nested residuals. While this procedure helps in time series estimation of the parameters along the Granger et. al. approach, it also provides a procedure for estimating TVP (Time Varying Parameter) problems as discussed in Rao (2000), without using any exogenous cost minimisation objectives.

In the first step we break up the pooled time series ARIMA model into nested models, identified by years, as follows:

$$[P_{t+1} - P_t] = [A_t + \sum_{i=1}^4 B_{it} \text{ historical variable }_{it} + \sum_{i=5}^8 B_{it} \text{ expectation variable }_{it} + \eta_t]_C \otimes_T$$

where C is the no of companies in the data set, T is the time “ horizon” which in this case is 1990-2000 and B_{it} is the coefficient on historical variable i at time t where i is the indicator as follows:

i=1 ⇒ NW

i=2 ⇒ DE

i=3 ⇒ PT

i=4 ⇒ DIV

The historical variables are as given above, the expectation variables follow exactly the same identification i.e.

$$i=5 \Rightarrow E_t ? NW$$

$$i=6 \Rightarrow E_t ? DE$$

$$i=7 \Rightarrow E_t ? PT$$

$$i=8 \Rightarrow E_t ? DIV$$

This is the basic time series model.

The next step we break up this general ARIMA (1,1,1) specification into first a "bootstrap" average growth model as follows :

$$P_{2000} - P_{1990} = A + B_1 NW_{1990} + B_2 DE_{1990} + B_3 PT_{1990} + B_4 DIV_{1990} + B_5 E_{1990} ? NW_{2000-1990} \\ + B_6 E_{1990} ? DE_{2000-1990} + B_7 E_{1990} ? PT_{2000-1990} + B_8 E_{1990} ? DIV_{2000-1990} + \mathbf{\tilde{h}}$$

Where, $E_{1990} ? NW_{2000-1990} = NW_{2000} - NW_{1990}$,

$$E_{1990} ? DE_{2000-1990} = DE_{2000} - DE_{1990},$$

$$E_{1990} ? PT_{2000-1990} = PT_{2000} - PT_{1990}$$

$$E_{1990} ? DIV_{2000-1990} = DIV_{2000} - DIV_{1990}$$

Thus, here the dependant variable is the total price differential over the decade. Any of the coefficients B_5 to B_8 is the "average growth" coefficient in the sense for e.g.

$$B_5 E_{1990} ? NW_{2000-1990} = 10 B_5 E_{1990} \frac{?NW_{2000-1990}}{10}$$

This model seems as the benchmark "bootstrap" model for the decade of the 90s.

In the third step the linear growth assumption along with the 10-year horizon assumption is relaxed to test a set of ten "nested" models, one for each year as follows :

$$Ret_n = A_n + \sum_{i=1}^4 B_{in} \text{ historical variable } i + \sum_{i=5}^8 B_{in} \text{ expectation variable } i$$

$$+ \tilde{\epsilon}_n, \tilde{\epsilon}_n \sim N(0, \sigma_{\tilde{\epsilon}}^2), \quad n = 1999 \dots 1990.$$

and growth is taken over 1 year periods working back from 2000 for each n , and expectations is forward looking over the one year.

For example,

$$B_{15} E_1 ?NW_1 = B_{1999,5} (NW_{2000} - NW_{1999}) \text{ and so on}$$

$$Ret_n = P_{n+1} - P_n$$

Granger & Newbold (1977) argue, this is a valid procedure for obtaining the Time Series properties of Stock Price, provided the residual matrix $[\tilde{\epsilon}_n]$ does not show significant serial correlation. Therefore the final step in this algorithm is to check for the correlation in the $[\tilde{\epsilon}_n]$ matrix from the ten nested models obtained in step 3. If the significance of serial correlation is low then this is also a algorithmic procedure for cointegration of stock price variables. We test these hypotheses in the following sections.

TIME SERIES RESULTS (GOODNESS-OF-FIT)

The "Average Growth " Model

The average growth model for the ten year period 2000 - 1990 is presented. The dataset consists of the entire market data and the partitioned manufacturing data. Both the set of results serve as a bootstrapping benchmark for the linear model specification in the stage 1 of the modeling algorithm.

The Market Data

The total number of "surviving" firms between the decade 31.12.90 and 31.12.2000 is 573 in the total market dataset. The average growth model was run on the set taking annual series as has been discussed. The results are summarised in the following table:

Variable	B	t (573)	Level of significance
Intercept	-16.47	-1.298	Insignificant
NW ₁₉₉₀	-0.165	-1.225	Insignificant
DE ₁₉₉₀	0.085	0.079	Insignificant
PT ₁₉₉₀	2.819	4.33	1%
DIV ₁₉₉₀	23.30	6.823	0%
GNW ₂₀₀₀₋₁₉₉₀	-2.909	-3.227	1%
GDE ₂₀₀₀₋₁₉₉₀	0.875	0.106	Insignificant
GPT ₂₀₀₀₋₁₉₉₀	21.355	4.415	1%
GDV ₂₀₀₀₋₁₉₉₀	326.194	14.356	0%

Thus, the estimated equation becomes:

$$P_{2000} - P_{1990} = -16.47 - 0.165NW_{1990} + 0.085 DE_{1990} + 2.819 PT_{1990} + 23.30 DIV_{1990}$$

$$(-1.298) \quad (-1.225) \quad (0.079) \quad (4.33) \quad (6.823)$$

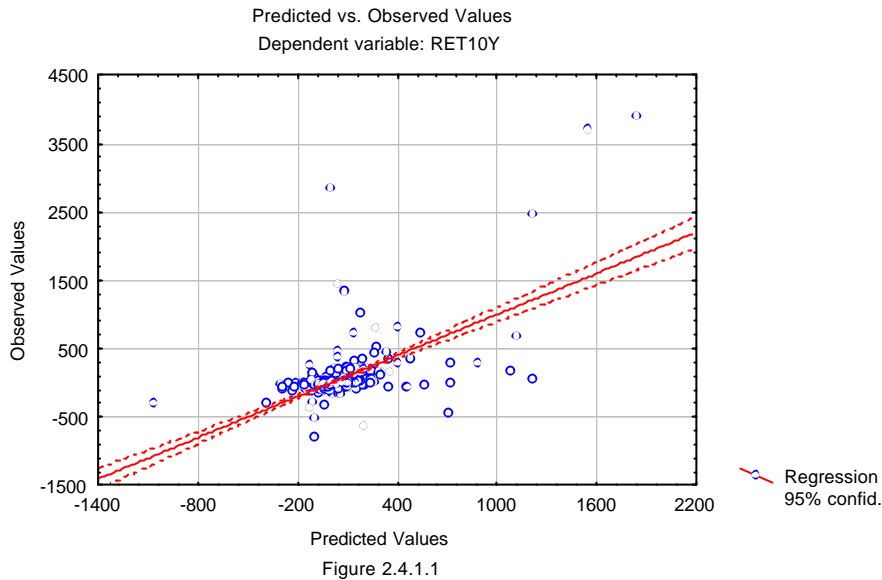
$$-2.909 GNW_{2000-1990} + 0.875 GDE_{2000-1990} + 21.355 GPT_{2000-1990} + 326.194 GDV_{2000-1990}$$

$$(-3.227) \quad (0.106) \quad (4.415) \quad (14.356)$$

The R^2 is high at 0.36 and the F-statistic is high at 42.09366 which is significant at the 0% level and the serial correlation of the residuals is low at 0.05 suggesting a good fit for the model.

The signs of the significant weights on the initial profit (PT_{1990}), initial dividend (DIV_{1990}) and in their growth is substantiated by the model, while the negative weightage on $GNW_{2000-1990}$ seems

to be arising due to the predominance of the supply factors over demand in the fixed point equation of the model. The fitted "price differential" line is plotted in fig. 2.4.1.1. as RET 10Y.



Manufacturing Sector Data

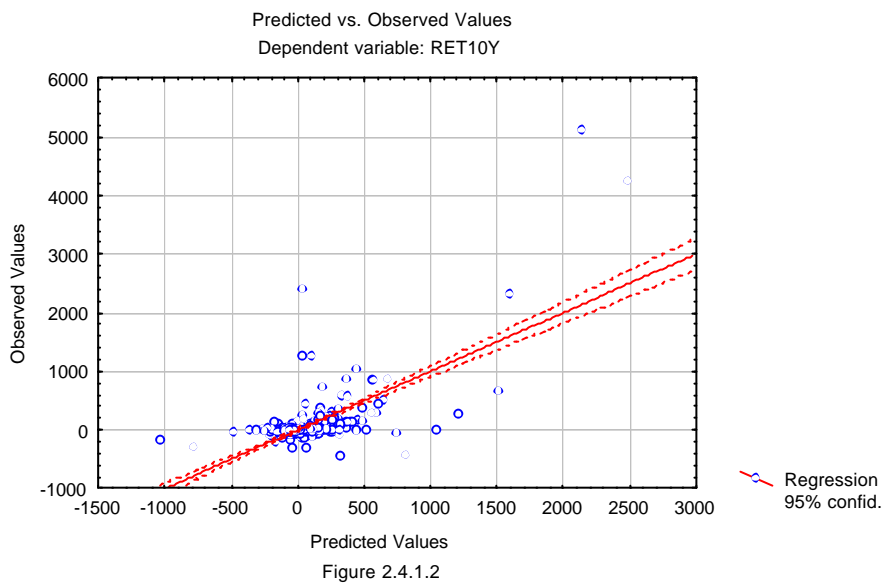
The total number of "surviving " firms in the manufacturing sector dataset over the period 2000 - 1990 is 517. The average growth linear model was run on the dataset taking annual series, as has been discussed, to obtain the GLS estimates. The results are presented in the following table:

Variable	B	t (573)	Level of significance
Intercept	-20.47	-1.425	Insignificant
NW ₁₉₉₀	0.215	1.003	Insignificant
DE ₁₉₉₀	0.069	0.061	Insignificant
PT ₁₉₉₀	2.967	4.04	1%
DIV ₁₉₉₀	30.885	6.504	0%
GNW ₂₀₀₀₋₁₉₉₀	-5.987	-5.586	0%
GDE ₂₀₀₀₋₁₉₉₀	1.273	0.146	Insignificant

GPT ₂₀₀₀₋₁₉₉₀	37.317	6.716	0%
GDV ₂₀₀₀₋₁₉₉₀	441.713	16.69	0%

The R² is high at 0.46.

The graph of the plot of the fitted price differential is shown in figure 2.4.1.2.



Annual Price Differential Data

In keeping with the algorithmic approach to the time series analysis of this paper we regress the model on annual data for the periods 2000-1990. The results of the regression for the various periods within the decade are summarized in the following table 2.4.1.3.1.

Table 2.4.1.3.1

period	Intercept	NW	DE	PT	DIV	GNW	GDE	GPT	GDIV	R ²	F	DW
00-99	-4.2 (-1.39)	-0.021 (-0.46)	0.023 (0.163)	0.419 (2.30)	-16.87 (-19.14)	-0.33 (-3.54)	0.01 (0.11)	0.977 (5.01)	-13.49 (-11.40)	0.19	73.24	1.80
99-98	22.88 (5.74)	0.098 (2.79)	-0.05 (-0.14)	1.02 (7.15)	7.54 (6.78)	0.21 (3.44)	-0.04 (-0.24)	1.15 (6.45)	6.29 (5.04)	0.08	34.38	1.76
98-97	3.38 (3.84)	0.019 (4.57)	-0.01 (-0.11)	0.18 (3.47)	-3.16 (11.86)	0.34 (-8.14)	0.00 (0.08)	0.61 (8.4)	1.28 (4.07)	0.08	39.18	1.97
97-96	7.52 (5.72)	0.04 (6.08)	-0.15 (-1.06)	-0.39 (-8.02)	-11.21 (-28.23)	-0.56 (-25.18)	0.01 (0.17)	-0.5 (-5.3)	7.02 (9.03)	0.34	226.20	1.97
96-95	3.01 (1.71)	-0.31 (-11.24)	-0.00 (-0.001)	1.13 (9.61)	-7.52 (-10.20)	-0.55 (-8.23)	-0.01 (-0.05)	-0.63 (-6.92)	4.04 (3.03)	0.27	147.86	2.02
95-94	-13.15 (-3.45)	-0.68 (-11.48)	0.01 (0.07)	1.35 (6.19)	-5.13 (-3.54)	-0.53 (-7.21)	-0.02 (-0.16)	2.14 (11.78)	-14.11 (-6.73)	0.24	89.38	1.99
94-93	37.6 (3.75)	1.19 (8.85)	-0.07 (-0.11)	-1.58 (-3.61)	-14.11 (-4.61)	0.13 (0.68)	-0.05 (0.09)	0.36 (0.85)	-11.4 (-1.99)	0.09	19.29	1.97
93-92	6.55 (2.50)	0.07 (2.44)	-0.16 (-0.44)	-0.07 (-0.66)	0.699 (1.16)	-0.06 (-1.71)	-0.005 (0.06)	0.323 (4.23)	4.962 (3.385)	0.07	11.67	2.02
92-91	0.79 (0.26)	0.058 (1.957)	-0.273 (-0.805)	0.52 (4.37)	5.82 (6.926)	0.008 (0.157)	-0.293 (-0.861)	1.251 (9.167)	8.552 (6.187)	0.26	42.55	2.12
91-90	20.12 (3.86)	0.09 (1.67)	0.04 (0.07)	-0.53 (-2.43)	8.84 (6.36)	-0.29 (-2.33)	0.034 (0.07)	0.64 (3.074)	2.883 (2.98)	0.14	17.40	2.11

The fit of the ten annual models never perform better than the average growth model over the 10-year horizon in terms of R², which has a significantly high R² at 0.36. Besides, the F-statistic is significant for the average growth rational expectations model over 10 years and the serial correlation of residuals is also low, rejecting a non-linear fit to the pricing equation through annual series in favour of a linear fit. This inference is correct based on the comparison of the two sets of models, because as required by Granger & Newbold (1977), the error correlation matrix among the nested residuals as given in table 2.4.1.3.2 does not show significant serial correlation.

Table 2.4.1.3.2

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	1.00	-.04	-.01	.01	-.07*	.01	.04	.07*	-.01	-.00
E2	-.04	1.00	-.03	-.04	-.04	.01	.02	-.02	-.00	-.00
E3	-.01	-.03	1.00	-.01	-.01	-.03	-.03	-.02	-.00	.04
E4	.01	-.04	-.01	1.00	.00	.00	.01	-.02	.01	.02
E5	-.07*	-.04	-.01	.00	1.00	-.03	.02	.02	-.02	.00
E6	.01	.01	-.03	.00	-.03	1.00	.02	.05	-.01	-.01
E7	.04	.02	-.03	.01	.02	.02	1.00	.03	.01	.16*
E8	.07*	-.02	-.02	-.02	.02	.05	.03	1.00	-.04	-.02
E9	-.01	-.00	-.00	.01	-.02	-.01	.01	-.04	1.00	.00
E10	-.00	-.00	.04	.02	.00	-.01	.16*	-.02	.00	1.00

Marked correlations are significant at $p < 0.05000$

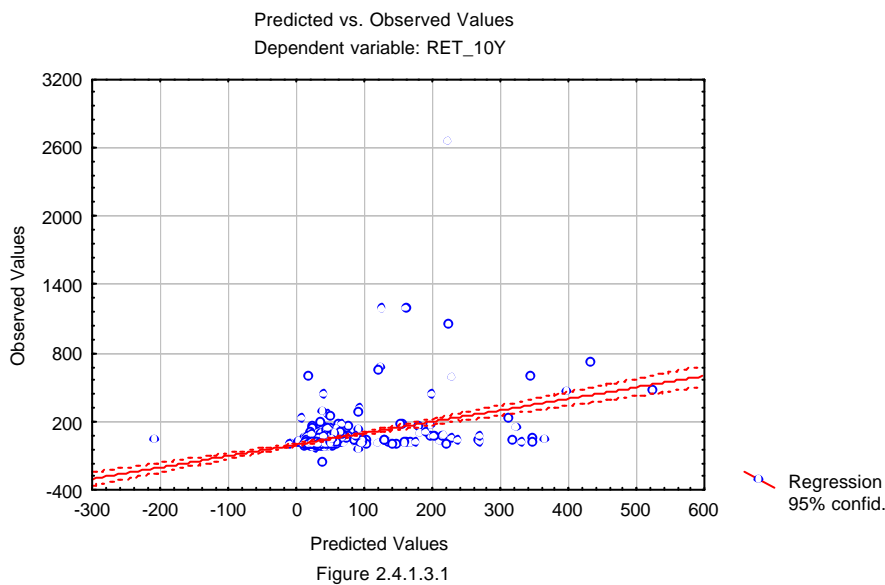
This rejects the hypothesis of significant correlation with only 3 out of 45 correlations being significant and that too with a maximum magnitude of 0.16. This inference is also true when one compares the manufacturing sector for its fit over 2000-1990 with 2000-1999 the most recent one year. The results for the 2000 -1999 period are given in table 2.4.1.3.3.

Variable	B	t-statistic	Level of significance
Intercept	-3.91	-1.057	Insignificant
NW ₉₉	0.007	0.183	Insignificant
DE ₉₉	0.02	0.129	Insignificant
PT ₉₉	0.327	1.564	Insignificant
DIV ₉₉	-21.09	-19.967	0%
GNW	-0.27	-2.483	2%
GDE	0.005	0.065	Insignificant
GPT	0.832	3.733	1%
GDV	-18.197	-13.214	0%

Adjusted R² is 0.23.

Here also the average growth ten-year model obtains a better fit, suggesting that the longer term linear rational expectations model performs better. In other words, the cointegrated price variables fit better in both cases with a linear average growth trend. Both these observations are somewhat incongruous with a high and significant weightage on historical dividends and dividend growths, which suggest high liquidity preference and therefore "myopia".

The fitted lines for the ten year average growth model and for the 2000-1999 model for the entire market data set are presented in figures 2.4.1.3.1 and 2.4.1.3.2.

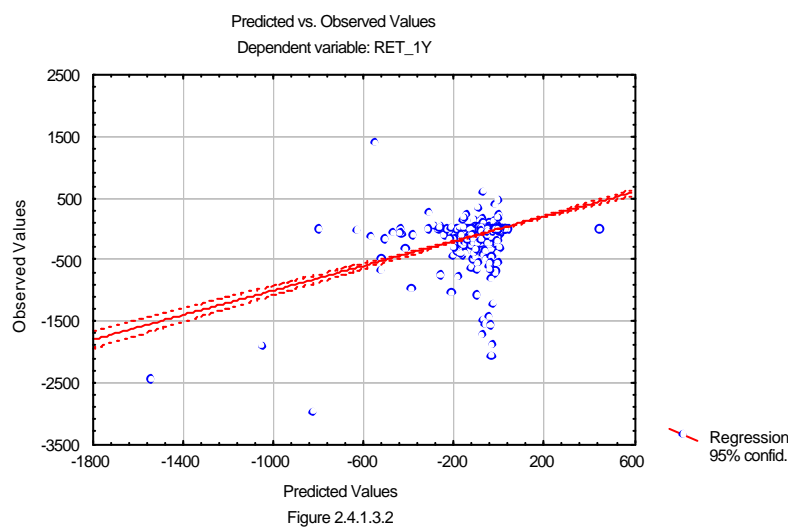


TIME SERIES RESULTS (VOLATILITY)

An analysis-of-fit of the model to the time series data reveals that on average a good part of the dynamic price differential is explained by the set of historical and rational expectations variables. The result shows an overall \bar{R}^2 (adjusted for serial autocorrelation and heteroskedasticity) of 0.36

with significant t-statistic on all but the debt-equity variables. The fit of the model is more striking in the case of the manufacturing sector. However, it still leaves a lot of volatility to be explained.

When it comes to an analysis of the volatility in the residuals it is observed that as was true in the cross-section data the F-statistic and DW-statistic are both significantly high, leaving therefore the variance to be analysed only. Further an analysis of the correlation matrix across the various "nested " models of annual duration suggest that the across the period serial correlations are insignificant. This not only points to the existence of a ten year set of data cointegrated with the price differentials but also to the fact that residuals are "random walks" over time at least within this ten year history. However, after the conditioning on the variables of the model the errors do follow a "random walk" pattern. Variability reducing policies targeted at the short-term annual performances are necessary in this respect. What type of instruments co-vary with these annual residuals so as to reduce them is a question which requires consideration. Behaviourally speaking "myopia" through dividend and expected dividend dependence operates in contrast to the overriding performance of the longer term "average growth " model. This is an anomaly like the "Hindu" rate of growth in India. However, the significant variance of the residual sum of squares does certainly point direction to speculative "gambling" and "sunspot"



components in the stock market. The plot of the distribution of residuals in the ten year average growth model for the total market and manufacturing sector datasets are presented in figures

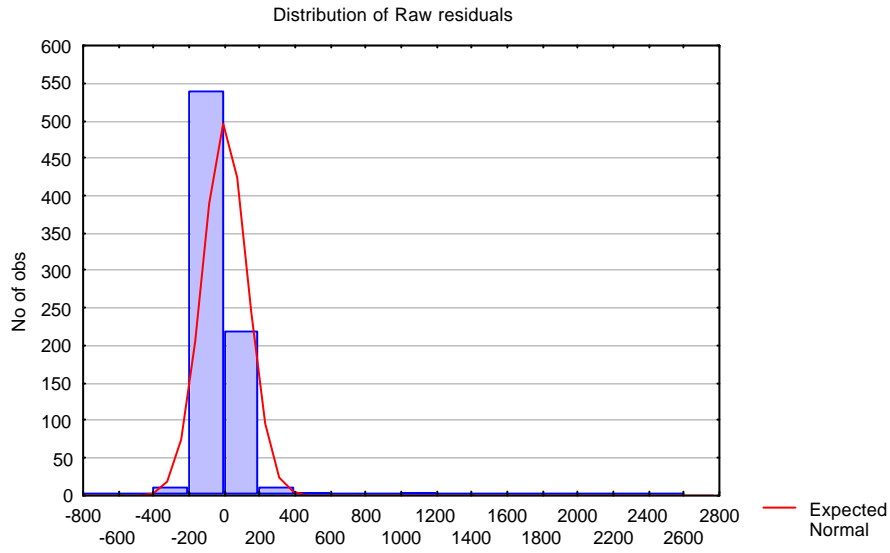


Figure 2.5.1

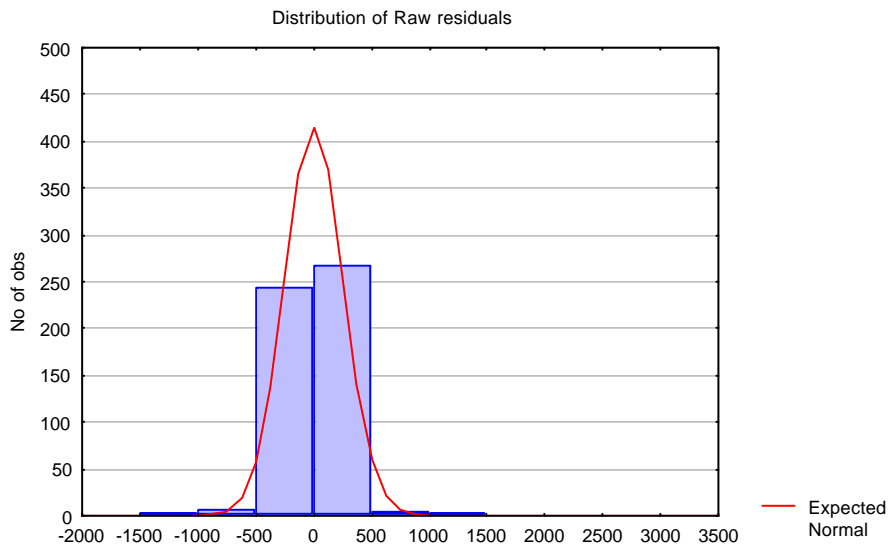


Figure 2.5.2

2.5.1 and 2.5.2.

CONCLUSION

The structure of the financial markets in India is described by the presence of historical real (net worth per share, profitability per share) and financial (debt-equity ratio, dividend distributed per share) variables as well as their rationally expected growth values over the future. This structure is cointegrated with the stock price so that it may be said that in corporate governance, price is an important consideration in making decisions on the above explanatory variables at the corporate level. This is in the light of the fact that although there is a lot of residual volatility, lack of explosive components makes cointegration possible. If one compares it with the fact that the relationships within the model are stronger in the annual data in periods distant from 1993 and 1997, the two periods of crashes and other significant events, as discussed in the beginning (which therefore opens up areas of further analysis of structural breaks), then the linear fit, on average, suggests that, albeit a high degree of volatility, "planned competition" has been responsible in preventing markets from crashing more often, and changing the overall structure of the interplay between price formation, history and expectations along with it.

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