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The Behaviour of Stock Returns in an Emerging Market: A Case Study of Pakistan

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I. INTRODUCTION

In developed market economies, the stock market is a major conduit of financial resources from surplus units to deficit units. This transfer of funds is mutually advantageous to both parties. The recipients of these funds, publicly owned companies, are enabled to utilise them in profitable investments, while the surplus units, ultimately households, are provided an opportunity in sharing in the future profits of these enterprises. More importantly, by providing an active market for existing corporate securities, the stock market is also able to fulfil the liquidity needs of surplus units.

The most significant academic developments in finance in the past twenty-five years have been portfolio theory, capital market theory, and efficient market theory, collectively called modern finance theory. These modern developments, based on the pioneering works of Markowitz (1959) and Sharpe (1964), and accumulating empirical evidence suggest that financial investors are well advised to make their decisions assuming that security prices fully and instantaneously reflect all publicly available information. This proposition is often referred to as the random walk hypothesis, which implies that successive security prices/returns are not statistically associated.

Furthermore, the relevant risk measure for which investors should expect to be compensated for when buying a financial asset is not that asset's expected total variability in return since a portion of this variation will be diversified away in efficient portfolios. Instead, the proper measure of the asset's risk contribution is its beta coefficient, which is based on the covariation between the asset's returns and returns on a market portfolio. The higher this covariation, the more the asset contributes to the risk of a well-diversified portfolio and therefore the higher the

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Author's Note: I am grateful to the Pakistan Institute of Development Economics for its hospitality during the annual conference. I appreciate Ijaz Nabi's comments but disagree with his observation that this type of study is rather premature given that the Pakistani market has recently been liberalised and it would take time for the effects to work themselves out. It is precisely for that reason that this study is relevant since it looks at the past performance of the stock market thus providing a basis for comparison with the future performance of the equity market.

required return on holding this asset. This insight has led to the development of the well-known Capital Asset Pricing Model (CAPM).[1]

These propositions of modern finance theory have been subjected to extensive empirical tests based on the behaviour of stock returns of major national stock markets. Smaller markets (specifically of developing countries), on the other hand, have not received much attention. This is probably due to the fact that these markets generally lack the depth, regulatory framework, and structural safeguards that characterise equity markets in the United States and in a few industrial countries. Moreover, trading in these markets is often restricted to shares of a limited number of firms. Trading in most other listed stocks is usually thin and sporadic, thus lacking the continuous and orderly nature of price movements which is typical of U.S. markets. Finally, there is lack of information on stock price movements over sufficiently small intervals of time i.e. daily, weekly or monthly stock prices. Given these problems, it is understandable that empirical tests for market efficiency and CAPM have not been pursued with much vigor, if at all, for developing countries' stock markets.

However, given that stock markets in developing countries do offer the opportunity for substantial profits to financial investors and that some of these are beginning to assume a major role in the flow of savings, their operation and the nature of their stock price behaviour needs to be more fully understood. This paper focuses on the latter and examines the behaviour of returns of an important emerging financial market, the Pakistan stock market.

Whereas the Karachi Stock Exchange has been in operation since 1949 and the Lahore Stock Exchange started trading in 1971, till about 1980 or thereabouts, these exchanges played a relatively minor role in channelling national resources into productive investment. Between 1960 and 1981 the State Bank of Pakistan's general index of share prices increased at an annual compounded rate of 3.3 percent whereas between July 1981 and June 1992, it grew at an annual compounded rate of 19.74 percent. According to the International Finance Corporation (1992), of the emerging stock markets monitored by it, Pakistan ranked third, after Argentina and Colombia, in terms of one-year performance in 1991. Also the number of listed companies on the two exchanges has doubled over the 1981–1992 period.

These significant developments in the Pakistan stock market are generally attributed to the government's increasing liberalisation measures that provided for the loosening of foreign exchange controls, opening up the stock market to foreigners, repatriation of profits, and the easing of investment and banking sector regulations. More importantly, Pakistan has a large privatisation programme underway through which more than one hundred state-owned companies from diverse industries are being transferred to the private sector. These developments augur well for the Pakistan stock market. It is beginning to play a major role in the

[1]For an excellent survey of the evolving literature on the pricing of assets and the structure of financial markets see Blume and Seigel (1992). See also Fama (1991).

channelling of financial resources for productive purposes. Moreover, given that the tenets of Islam have nothing against equity participation by investors and given the increased emphasis of the government for a free-market economy guided by Islamic principles, it can be expected, with much confidence, that the stock market will continue to grow rapidly, possibly at the expense of markets for debt.[2]

There has been no study that has analysed the bahaviour of stock returns in Pakistan, especially between the 1981–1992 period. This paper represents a first effort in remedying that an attempts to shed light on the time-series behaviour of stock index returns in Pakistan. It is organised as follows. In Section II the data are described and the results from conducting several tests of hypotheses are discussed. Section III posits and estimates a model of time-varying behaviour of expected returns and reports the results. Section IV concludes the paper by summarising the main findings, presents the limitations of the paper and suggestions for further research.

II. DATA AND PRELIMINARY ANALYSIS

The data used for this paper include monthly stock returns for the period July 1981 to June 1992 for a total of 131 observations. The returns are calculated as logarithmic first differences of the State Bank of Pakistan's (SBP) General Index of Share Prices in local currency.

In total, eleven series of returns are examined statistically. The first series represents SBP's overall index of share prices, which is a value weighted and broadly based index of the stock market. The other ten series represent general indices of share prices of specific industrial groups. These include share prices of firms producing the following products: (1) Cotton and Other Textiles (2) Chemicals (3) Engineering (4) Sugar and Allied Industries (5) Paper and Board (6) Cement (7) Fuel and Energy (8) Transport and Communication (9) Insurance and Finance and (10) Miscellaneous Industries selling tobacco, jute, and vanaspati and allied products.

Table 1 reports statistics that should give a general idea of the distribution and characteristics of the different stock indices. All monthly mean returns (column 1) are positive. However, only the sample mean returns based on the indices of the overall market, cotton and other textiles, chemicals, and fuel and energy, are statistically different from zero for two-tailed tests at the 10 percent level of significance.

The Pearson's coefficient of skewness (column 3) indicates that the majority of the returns series are positively skewed. In the three cases where the coefficient of skewness is negative, it is not statistically significant. The kurtosis coefficient (column 4) implies that all the returns series are highly leptokurtic. The *p*-runs

[2]It is only the author's view that equity participation is not inconsistent with the tenets of Islam based on a casual reading of the Islamic economics literature. No slight is intended and the author would be glad to be corrected if this impression is erroneous.

statistic (column 5) is the level of significance at which the hypothesis of randomness of actual returns around the sample mean return can be rejected. Only in the case of chemical, engineering, and insurance stocks is the randomness of stock returns around the sample mean return rejected.

Table 1

Statistics on Pakistan Stock Market Returns

Index	Mean (*t*-value)	Stdev	Skewness	Kurtosis	*P*-runs	Beta (*t*-value)	*Q*-statistic
General	0.0156 (4.11)	0.0434	0.2169	8.82	0.5499	–	19.7
Cotton	0.0098 (1.72)	0.0590	0.3394	6.32	0.8187	0.9807 (6.79)	2.92
Chemical	0.0110 (2.29)	0.0499	–0.0144	9.49	0.0154	0.9412 (8.25)	9.14
Engineering	0.0057 (0.50)	0.1181	0.1519	39.53	0.0004	1.0118 (3.05)	22
Sugar	0.0110 (1.35)	0.0842	–0.0064	13.63	0.6279	0.8256 (3.54)	12.6
Paper	0.0087 (1.44)	0.0626	0.1342	14.91	0.1563	0.732 (4.33)	18.6
Cement	0.0064 (0.87)	0.0760	0.0904	10.56	0.9583	1.4601 (8.50)	7.4
Fuel	0.0123 (2.06)	0.0615	–0.0991	11.01	0.9162	1.0873 (7.45)	8.85
Transportation	0.0066 (1.14)	0.0598	0.3690	7.60	0.3782	1.0393 (7.25)	19.2
Insurance	0.0134 (0.72)	0.19123	0.1032	45.77	0.0479	0.7846 (1.41)	18.1
Miscellaneous	0.0054 (0.65)	0.0859	–0.0042	33.47	0.3827	0.9855 (4.23)	17

Note: Mean = sample mean returns; Stdev = sample standard deviation; Skewness = Pearson's coefficient of skewness; Kurtosis = coefficient of kurtosis; *P*-runs = level of significance where the null hypothesis of random runs can be rejected; Beta = covariation between the stock index and the general index; *Q*-statistic = *Q* statistic for sixth-order (or less) autocorrelation of stock returns.

Based on the assumption that the overall index is broadly based and the returns implied by it represent the returns on the market portfolio, the beta parameters of the different industrial groups were estimated through least squares

regressions and are also reported in column 6 of Table 1. The point estimates of beta vary from a low of 0.732 for paper to a high of 1.46 for cement. According to the CAPM, these estimates imply that well-diversified portfolios of paper industry stocks have less risk and that of cement stocks are more risky than a market portfolio in Pakistan. Consequently, the required rate of return should be lower for paper industry stocks and higher for the cement industry stocks, relative to the market rate of return. Indeed, this prediction of CAPM could be tested by comparing the actual mean returns to those predicted by the individual industry betas. However, given the size of the standard errors on the betas the hypothesis that they are not different from 1 can be rejected only for cement stocks implying equal risk for a broad market-based portfolio and portfolios comprising of one industry stocks in Pakistan.

To see whether the sample means were statistically different and F test of the equality of all sample means was conducted. The hypothesis that all sample means are equal was not rejected at the 1 percent level of significance.[3] Given the equality of means and of the historical betas, it can be concluded that a portfolio consisting of one industry stocks performs as well, if not better, as a market portfolio.

Finally Table 1 reports the Q statistics (column 7) for the sixth and lower order of autoregression in the returns. The critical value of this statistic (which is distributed $\times^2$) is 12.59 at the 5 percent level of significance. Generally the first-order autocorrelations (not reported) for most series were significant at the 5 percent level of significance and the higher order autocorrelations (though significant) decay over longer lags. The significance of the autocorrelation coefficients, as implied by the Q statistic, for most indices indicates that the returns may be modelled as autoregressive processes.[4]

III. MODEL AND ESTIMATION OF STOCK RETURNS

The returns embodied in the various stock indices represent returns that would have accrued to a portfolio containing all these stocks in proportion to their value. The question is what determines these returns at time t? Clearly it would be the information that is available till time $t-1$. Therefore the actual return at time t, R_t, should consist of the expected return conditional upon the information set at time $t-1$, $E(R_t | I_{t-1})$, plus a white noise error term, u_t, reflecting inefficiencies in information processing. More formally:

$$R_t = E(R_t|I_{t-1}) + u_t = \mu_t + u_t \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

and

$$E(u_t|I_{t-1}) = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

[3]This test is valid provided the underlying populations are normal and have equal variances. It is reported to convey a general idea about the differences in the means. They probably are different.

[4]The positive autocorrelations may be consistent with the presence of microstructure biases caused by infrequent or nonsynchronous trading. See Conrad and Kaul (1988).

As the expected returns, μ_t, are not observable, we need to specify an expected return generating process, i.e., what constitutes the information set? One approach would be to use predetermined variables that have significant correlations with realised stock returns such as the risk free rate of return, dividend yield, money growth, and GNP etc. However this is an option not available to us given the lack of monthly observations on most of these series.

Following the works of Rosenberg (1973); Conrad and Kaul (1988) and Koutmos and Lee (1991), and given our findings reported in Section II of significant first-order autocorrelations in most of the series of returns, we assume that the conditional expected return is characterised by an error correcting, first-order autoregressive process of the following form:

$$\mu_t = \mu + \phi\,(\mu_{t-1} - \mu) + v_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

It is assumed that the conditional expected return, μ_t, tends to converge to the long-term (population) mean return, μ. The adjustment factor is ϕ and v_t is an error term with mean zero and variance σ^2_v. Several models used in the literature can be derived from this specification which is similar to Rosenberg (1973) and Koutmos and Lee (1991). If $\phi = 0$, then (3) reduces to the random coefficient model implying that the expected return is constant over time. A value of $\phi > 1$ would imply a nonstationary process while $\phi = 1$ would imply a nonstationary random walk model. If μ, the long-term rate of return, is zero then (3) becomes an ARMA (1, 1) process as employed by Conrad and Kaul (1988).

Since μ_t are not observed, they need to be estimated. The Kalman filter technique is employed to estimate Equations (1) and (3) which, in the state space model terminology, represent the observation and system equations respectively.[5] Given estimates of the fixed parameters, the Kalman filter recursively updates estimates of the stochastic parameters of the model. Assuming that the returns are normally distributed the parameters of the conditional distributions of μ_t and R_t, given information till time $t-1$, are:[6]

$$\mu(t \mid t-1) = \phi\mu\,(t-1|t-2) + (1-\phi)\mu \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

$$S^2_\mu = \phi^2\, S^2_\mu(t-1|t-2) + \sigma^2_v \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

$$R(t \mid t-1) = \mu(t \mid t-1) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

[5]A clear introduction to the Kalman filter is given by Meinhold and Singpurwalla (1983). A detailed discussion of it is in Newbold and Bos (1985).

[6]If the returns are not normally distributed, the Kalman filter gives best linear unbiased predictions.

$$S_R^2\,(t \mid t-1) = S_\mu^2\,(t \mid t-21) + \sigma_u^2 \qquad \ldots \quad \ldots \quad \ldots \quad (7)$$

Equations (4) through (7) are the prediction equations where $\mu\,(t \mid t-1)$ and $R(t \mid t-1)$ are the expected values and S_μ^2 and S_R^2 are the variances of μ_t and R_t and σ_u^2, σ_v^2 denote the variances of the errors u_t and v_t. The updating equations for μ_t and S_μ^2 are as follows:

$$\mu(t \mid t) = \phi\mu(t-1 \mid t-1) + (1-\phi)\,\mu + . S_\mu^2\,(t-1 \mid t-1)\,[R_t - \mu(t \mid t-1))]/\,S_R^2\,(t \mid t-1) \qquad \ldots \quad (8)$$

$$S_\mu^2\,(t \mid t) = S_\mu^2\,(t \mid t-1) - S_\mu^4(t \mid t-1)/S_R^2\,(t \mid t-1) \qquad \ldots \quad \ldots \quad (9)$$

The fixed parameters of the model are the long-term mean μ, the adjustment coefficient ϕ, variance of u_t, σ_u^2 and the variance of v_t, σ_v^2. These are obtained by the maximising the following likelihood function:

$$Log\,L = -\,(1/2)\sum_{t=1}^{N} log[S_\mu^2\,(t \mid t-1)] - (1/2)\sum_{t=1}^{N} [[R_t - \mu(t \mid t-1)]^2/\,S_\mu^2\,(t \mid t-1)] \qquad \ldots \quad \ldots \quad (10)$$

The Berndt, Hall, Hall and Haussman (1974) maximum likelihood estimation technique is used for this to obtain estimates of the fixed parameters μ, ϕ, σ_u^2, and σ_v^2 . Equations (4) through (9) then are used to compute the point estimates of expected returns and their associated standard errors. The results are reported in Table 2.

The estimated long-term expected return, reported in column 1, is positive and statistically significant at the 20 percent or lower levels of significance for five indices. These indices represent all stocks (general), chemical industry, fuel and energy, transportation, and sugar and allied products. The long-term expected return for these indices ranges between .0074 for transportation and .0163 for the overall index. This implies annual returns of 9.25 percent for transportation and 21.41 percent for the overall index. The point estimates for the other indices, are positive but not statistically significant at any conventional levels of significance.

The statistically insignificant estimates of σ_v^2, reported in column 4, for all indices strongly suggests that the expected return in Pakistan stock markets is

Table 2

Kalman Filter Estimates of the Equations $R_t = \mu_t + u_t$ *and* $\mu_t = \mu + \phi\mu_{t-1} + v_t$*: July 1981 to June 1992. (N = 131)*

Stock Index	$\hat{\mu}$	$\hat{\phi}$	$\hat{\sigma}_u^2$	$\hat{\sigma}_v^2$	$\hat{\rho}_1$
General	.0163	.0014	.0018	.0036	.1945
	(4.05)	(.0058)	(14.18)	(.006)	(2.23)
Cotton	.0088	.0076	.001	.0024	.1099
	(1.49)	(.006)	(.002)	(.006)	(1.12)
Chemicals	.0107	.0033	.0042	.0109	−.0293
	(1.88)	(.0102)	(2.51)	(.130)	(−.2960)
Engineering	.0040	.0025	.0140	.0002	.0571
	(.413)	(.0002)	(.007)	(.0001)	(.570)
Sugar	.0111	−.0073	.0065	.0007	−.0672
	(1.29)	(−0.001)	(.014)	(.0016)	(−.674)
Paper	.0085	−.543	.0053	−.001	−.099
	(1.06)	(−3.24)	(5.43)	(−1.19)	(−1.007)
Cement	.0074	−.789	.0065	−.0002	−.0463
	(.850)	(−6.41)	(11.77)	(−.991)	(−.4669)
Fuel	.0133	−.4679	.005	−.0006	−.0700
	(1.98)	(−.87)	(2.65)	(−.392)	(−.708)
Transport	.0074	.4893	.0045	−.0007	.051
	(1.41)	(2.18)	(5.15)	(−.94)	(.513)
Insurance	.0132	.0185	.0379	.0001	.021
	(.536)	(.005)	(.061)	(.001)	(.211)
Miscellaneous	.0055	.0189	.0075	.0002	.089
	(.534)	(.0002)	(.012)	(.0002)	(.903)

Note: Numbers in parentheses are *t*-statistics. The critical *t* value at the 20 percent (10 percent) level of significance for a two (one) tail test = 1.2817.

$\hat{\mu}$ = estimated long-term expected return; $\hat{\phi}$ = estimated autoregressive coefficient; $\hat{\sigma}_u^2$ = estimated variance for the observation error; $\hat{\sigma}_v^2$ = estimated variance for the system error; $\hat{\rho}_1$ = first-order autocorrelation coefficient of the residuals.

constant.[7] This finding is opposite to the findings of Conrad and Kaul (1988) and Koutmos and Lee (1991) who were unable to reject the hypothesis of constant expected returns for the U.S. and other major stock exchanges respectively. However they were using weekly data compared to our use of monthly data. While the use of monthly data is helpful in studying longer-term relationships, one effect of averaging stock prices over a month may have been the removal of the trend in the expected returns.

On examining the parameter estimates of the adjustment coefficient ϕ, our findings of constancy of expected returns are reinforced. Except for the transportation and paper indices, the estimates of ϕ are not statistically significant. In column 5 we report the estimates of the first-order auto-correlation coefficient of the residuals. Except for the overall index, these coefficients are not statistically different from zero implying that the parameter estimates are efficient.

IV. CONCLUSIONS

This paper has investigated the time-series behaviour of monthly stock returns in Pakistan over the period July 1981 to June 1992. The State Bank of Pakistan's indices of share prices are used to calculate the monthly stock returns for eleven groups of stocks. These consist of an overall (market) index and indices reflecting the stock market performance of ten mutually exclusive industrial groups.

Our findings are that the distribution of the returns of the various series are not normal and are generally positively skewed, leptokurtic, and have a positive mean. The actual returns vary randomly around the mean return.

Assuming that each industrial group represents an efficient and diversified portfolio, historical betas for them were estimated and were found to be statistically different from zero but not one. These results imply that investors in the Pakistan stock market who have diversified portfolios comprising of stocks of different industries are subject to the same amount of risk as investors with one industry portfolios.

Using an error correcting, first-order autoregressive model and employing the Kalman filter estimation technique, we attempted to determine the time varying behaviour of monthly expected returns. Our findings were that the expected monthly returns are constant and equal to the long-term expected monthly return for all portfolios. While this may not be a surprising result for a country with a highly developed financial system and in fact most researchers assume constancy of expected returns, this result for Pakistan does cause us to wonder about the adequacy of the model and/or the data used. It is quite possible that weekly expected returns may be time varying and/or the model of monthly expected returns is

[7]After some algebra, it can be shown that the Kalman filter for this model (as $t \to \infty$) reduces to the simple recurrence relation $\mu_t = \mu_{t-1} + \alpha e_t$ where the smoothing constant α is a complicated function of the signal to noise ratio σ_ν^2/σ_u^2. If σ_ν^2 is zero, as our results imply, then μ is constant and α is zero.

characterised by a higher order autoregressive process. Using weekly data and selecting the appropriate order of the process for each stock index based on monthly data would represent important extensions of this study.

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Comments on "The Behaviour of Stock Returns in an Emerging Market: A Case Study of Pakistan"

The performance of a country's stock market is increasingly seen as a barometer of economic strength and stability. This is certainly the case in the newly industrialised countries of East Asia as well as among the baby tigers in the ASEAN region. In Pakistan, following the economic liberalisation in 1990, the stock market soared, successfully mobilising vast private savings for productive investments and came to be regarded as an indicator of the confidence placed by investors in Pakistan's future development potential.

Given this role, it is imperative that the stock market functions smoothly and is not corrupted by malpractices (such as insider trading, manipulation of stock issue etc.). The danger of such malpractices is seen clearly in the recent scandal on the Bombay stock exchange, which has been criticised by a Government of India commission for being a club for the benefit of a coterie of traders. Although, Pakistani stock exchanges have not been accused of such widespread fraud, financial sector abuse is not unknown. It is critical that stock markets are legally and institutionally organised along lines such that fraud is minimised, private savers are protected and the markets continue to function as efficient indicators of business confidence. This requires a proper understanding of the workings of the stock exchange. Some of the questions that need to be answered are: Are there enough traders and do they engage in insider trading? Are there enough stocks being traded? Is stock issue a problem; etc.? Answers to these questions may require setting up of credit rating agencies, deepening the market by listing more stocks and increasing the number of players, tighter supervision of the stock floor and the use of electronics for quicker and safer transactions. A fundamental lesson of the experience of other countries is that resolving problems at the early phase of the stock market would avoid more drastic remedial action down the road, which could be much more expensive.

This Ninth Annual General Meeting of the Pakistan Society of Development Economists has devoted a whole session to Capital Markets in Pakistan, and one would expect that this would be an excellent opportunity to take up some of the questions raised above. Unfortunately, Mr Khilji's paper does not adequately address these vital aspects of the stock market (the passing reference to these issues in the introduction is all too brief). I feel that a good opportunity was lost for providing and debating insights that could be of use to policy-makers.

Let me now turn to the paper itself and say at the outset that given its specific objectives, the paper is a useful addition to the thin body of literature on this aspect of the Pakistani capital market. The central objective of the paper is to put the

Pakistani stock market through statistical tests (the Random Walk Model which implies that successive security prices/returns are not statistically associated, and the Capital Asset Pricing Model that gives the conditions under which stocks are priced efficiently). The paper's central finding is quite startling: that a diversified portfolio of stocks in Pakistan is subject to the same amount of risk as holding any one stock and that the expected monthly returns to stocks are constant and equal to the long-term expected monthly return for all portfolios. This would be a surprising result even in the much older stock markets of Tokyo, New York and London; for it to be valid for Pakistan's fledgling market is truly incredulous. And, as the author himself suggests in the conclusion, it raises questions both about the underlying models of the paper as well as the statistical procedures used.

I would focus first on the statistical procedure; the paper uses monthly averages as its stock price series, which smothers out much of the variation in the series and renders it important as a measure of risk; a weekly or even a daily price series would have been more appropriate. The author does not explain why such a series was not used.

The other problem I have with the paper is that the test procedure completely ignores the fact (which is acknowledged in the early part of the paper) that the stock market received a great fillip from the 1990 economic liberalisation reform. This resulted in a dramatic upturn in stock prices and signalled a clear break from the past weak trends. Surely any test of stock market efficiency should be constructed conditional on this structural change in stock market performance.[1] The author may wish to take these recent developments into account in his future work on Pakistan's stock market.

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[1]For a detailed discussion of recent developments in stock prices, see Salman Shah's paper, "Capital market development", in *Financing Pakistan's Development in the 1990s*, edited by Anjum Nasim, Oxford University Press, 1992.