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RELATIONSHIP OF ECONOMIC AND FINANCIAL VARIABLES WITH BEHAVIOR OF STOCK RETURNS

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The paper examines the relationship of economic and financial variables with behavior of stock returns in ten industrial sectors of KSE using monthly data. An Arbitrage Pricing Model is estimated in which the risk premia vary in proportion to the conditional volatilities of the macroeconomic and financial innovations which follow an autoregressive specification and exhibit strong time-variation from month to month. To overcome the generated-regressor problem the methodology of Koutoulas and Kryzanowski (1996) has been followed with some modifications. Each model is estimated by using nonlinear seemingly unrelated regression technique. The study indicates that unanticipated realizations of economic and financial variables are significant determinants of movements in stock returns. The results also imply that the predictable volatility in economic and financial factors in general has an insignificant effect on risk premium.

1. Introduction

It is commonly believed that stock returns are exposed to systematic economic and financial news. Though there is no controversy regarding the effects of unanticipated changes in macroeconomic environment in general on stock returns, but less agreement exists on which macroeconomic variables are more relevant in this context and how these variables influence stock prices. Since there is no widely accepted economic theory

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that links stock market to various economic variables, economic intuition is used to determine the appropriate macro variables. Chen, Roll, Ross (1986), Brown and Otsuki (1989), Kryzanowski and Zhang (1992) and Koutoulas and Kryzanowski (1996) use the APT (Arbitrage Pricing Theory) and economic intuition to relate the American, Japanese and Canadian stock market returns respectively, to unanticipated changes in various macroeconomic variables. Since these studies find that macroeconomic variables influence stock returns significantly (as predicted by the APT), they lend support to the commonly held notion that economic fundamentals determine asset returns.

Another body of literature documents a number of unexplainable patterns in stock prices. The lack of any generally acceptable explanation and persistence of these patterns are the main reasons why they are referred to as market anomalies. A puzzling anomaly is the small-firm effect or scale effect. Reinganum (1983) finds that small capitalization firms listed on the New York stock exchange and Australian stock exchange have risk-adjusted returns that significantly exceed those of large market value firms. Numerous studies, using stock data for the US, Canada, U.K and Japan and other countries, have failed to adequately explain these effects.

Most of the empirical work on the stock market of Pakistan has been on the distributional characteristics and time series properties of stock returns at the Karachi Stock Exchange (KSE). Khilji (1993), Khilji (1994) and Husain and Uppal (1998) find that the distribution of stock returns in KSE is generally positively skewed, leptokurtic and has a positive mean. Khilji (1994) and Husain (1997) observe that monthly returns adjust slowly to new information because they are time dependent. In another study Husain (1998) observes a significant decline in volatility in the months of Ramadhan (the fasting month of the Muslim calendar) with no significant change in the average return. Husain (2000) finds that the rates of return are lowest on the first trading day of the week. Uppal (1994), Zaman (1997), Shirazi (1999), Ahmed and Zaman (1999) use ARCH (Autoregressive Conditional Heteroskedastic) models to determine the effect of volatility clustering on stocker turns. Ahmad and Rosser (1995) use VAR (Vector Autoregressive) and ARCH models and observed that the Pakistani stock market exhibits complex dynamics.

The empirical evidence regarding the direction of causality between stock prices and macro variables is not conclusive. For example, Nishat and

Saghir (1991) and Ahmed (1999) have observed unidirectional causality from stock prices to consumption expenditure in Pakistan and Bangladesh respectively, while Mookerjee (1988) has observed the opposite case in India. Similarly, their findings are conflicting regarding the direction of causality between stock prices and economic activity and stock prices and investment spending. Husain and Mahmood (2001) reexamined the casual relationship between stock prices and macro variables like consumption, investment spending and economic activity. The paper indicates the presence of a long-term relationship between stock prices and macro variables. Further, the analysis indicates a one-way causation from macro variables and stock prices, implying that in Pakistan fluctuations in macro variables cause changes in stock prices

The purpose of this paper is to analyze the relationship of economic and financial variables with behavior of stock returns. The study is based on ten industrial sectors of Karachi Stock Exchange (KSE). It employs low frequency monthly data on stock market returns, GDP, industrial production, the inter bank call money rate, the term structure of interest rates, money supply, exchange rate, trade deficit, openness, inflation, and market capitalization over the period July 1985-July 2002.

The restrictive assumptions that assets returns are multivariate normal or preferences are quadratic, together with Roll's (1977) critique about the use of market index as a valid proxy for market portfolio when estimating the CAPM (Capital Asset Pricing Model), seriously challenge all the studies that use CAPM to adjust for risk. The APT is more general model that allows for more than one factor to influence returns, and does not require any restrictive assumptions on preferences.

Many studies that use the APT to test for anomalies do not specify the factors affecting returns. Instead these studies use factor analysis which has all the flaws revealed by Brown (1990), among others. Brown demonstrates that factor analysis understates the significance of risk premia on factors beyond the first one [i. e., it is biased towards choosing one factor even if an exact K-factor model is prespesified). Furthermore factor loadings are contaminated by bias resulting from the well-known two-pass procedure required for the creation of mimicking portfolios. As Burmeister and McElory (1988) show, avoiding this source of measurement error positively affects the robustness of the resulting estimations. Furthermore, the use of factor analysis as a statistical tool without any simultaneous grounding in economic theory (intuition) makes interpretation difficult and diminishes the operational significance of any findings.

Therefore to avoid the problems with factor analysis, this paper employs the Chen, Roll, Ross (1986) approach of pre-specifying the macroeconomic and financial factors that affect stock returns to estimate an APT model that allows for time varying risk premia [as done by Koutoulas and Kryzanowski (1996)]. The included variables are GDP, industrial production, money supply, exchange rate, inter bank call-money rate, inflation rate, trade deficit term structure of interest rate, and openness of the economy. The study considers overall KSE index and ten sectoral indices to measure stock market activities. The variables relating to stock market analyzed here are based on stock prices and market capitalization. The study is based on monthly data and the period under consideration is from July 1985 to July 2002. The novel feature of the analysis is the estimation strategy employed to overcome the generated regressor problem, which pervades some related research [for example Chen, Roll, Ross (1986) and Schwert (1989)]. Specifically, the procedure of employing a two-stage estimation process to first estimate innovations and variances of variables and then model their interrelationships yields inefficient estimates, introduces bias into a number of diagnostic test statistics and generates potentially invalid inferences. The problem is overcome in the model considered in this study. This problem is solved by jointly estimating the equations determining variances and innovations of individual variables and their interrelationships in the APT model in a framework of non-linear seemingly unrelated regression (NLSUR) equations. The estimation technique involves Zellner's iterative procedure.

The paper is structured as follows. Section 2 provides a simple theoretical guide to help choose the likely candidates for pervasive macroeconomic and financial variables. In section 3 the extended Arbitrage Pricing Theory (APT) model is presented. Data and results of estimation are discussed in section 4. The final section reviews the important results and draws together the conclusion.

2. Theory

The identification of the factors that affect stock prices can be accomplished through simple and intuitive financial theory. As postulated in Chen, Roll, Ross (1986) and Kearney and Daly (1998), the price of equity at any point in time is equal to the discounted value of expected future cash flows (including capital gains and dividends) to shareholders:

$$E_{t-1} P_t^i = E_{t-1} \left[\sum_{j=1}^{\infty} \frac{C_{t+j}^i}{(I + k_{t+j})^j} \right] \quad (1)$$

where P_t^i is the price of asset i at time t, C^i denotes the cash flows associated with it, $\frac{1}{1+k_{t+j}}$ is discount rate and E_{t-1} denotes the conditional expectation based on the information available at time *t-1*. It follows that the systematic factors, economic as well as financial, that influence stock prices are those that change expected cash flows and the discount rate. The choice of these macroeconomic and financial factors is dictated by several conditions. The general economic theory and intuition are the main inputs used in the selection process. The macroeconomic and financial factors that have been found to influence stock returns in past studies and data availability are also important inputs affecting the selection decision. Whether or not these variables appear in the popular financial media is also important consideration in final stage of selection process.

As mentioned by Chen Roll and Ross (1986), the discount rate is an average of rates over time and changes with both the level of rates and term structure spread across different maturities. So we use term structure (TS) and call money rate (CR) as two important factors influencing discount rate.

Short-term interest rate also fluctuates with economic conditions. Fama and French (1990) observe that short-term rates tend to be low in business contractions, especially at the low turning points of business cycle. These changes in short term interest rate due to changing economic conditions influence prices of stocks.

In an open economic and financial system, such as the one prevailing in Pakistan, corporate cash flows are influenced by developments in the macro economy such as the level of aggregate economic activity measured by GDP (Y), the level of aggregate industrial production (Q), the money supply (M), and the level of prices as measured by whole sale price index (WP), the external trading position of the country measured by the trade deficit (TD), the spot exchange rate (ER) which is defined as the domestic currency price of foreign currency and openness of the economy measured by the ratio of the sum of exports and imports to GDP (Gross Domestic Product).

Among the above-mentioned variables the level of activity in the overall economy and in the industrial sector are the variables designed to capture the real sector of the economy. They serve as indicators of current health of the economy and hence influence earning expectations of the investors. The money supply and call money rate capture the state of monetary and financial sector. Pak/US exchange rate and the trade deficit give the effect of foreign sector on stock returns. As mentioned by De Santis and Gerard (1998), any investment in the foreign assets is a combination of an investment in the performance of foreign assets and an investment in the performance of domestic currency relative to foreign currency. Thus variations in exchange rate reflect currency risk to shareholders whose objective is the maximization of returns and minimization of risk. The external trading position of the country also affects expected future cash flows as it serves as an indicator of economic stability to both domestic and foreign investors. The openness of economy shows the exposure to external real and financial markets shocks and instability in the composition of aggregate output and relative prices.

A puzzling anomaly of scale (or size) effect is also included in our analysis. According to this size effect, there is a negative association between the average return to stocks and market value of stocks at the firm level. Instead of individual firms our analysis is based on eleven stock price indices. We try to find out the presence of this size effect in our sectoral analysis.

In the light of the above discussion, we can write equation (1) as:

$$E_{t-1}P_t^i = E_{t-1}\sum_{j=1}^{\infty} f\left(C_{t+j}(Y_{t+j,}Q_{t+j}, M_{t+j}, WP_{t+j}, TD_{t+j}, ER_{t+j}, O_{t+j}), K_{t+j}(TS_{t+j}, CR_{t+j}), S^i\right) \quad (2)$$

Thus the expected price of ith stock price index is a function of the determinants of cash flows and discount rate, and market capitalization or size (S^i).

3. The APT With Conditional Macro and Financial Factors' Volatilities

The theoretical APT (Arbitrage Pricing Theory) model developed by Ross (1976) takes the following empirical form if the factors influencing stock returns are assumed to be observable [see McElory and Burmeister (1988) for details].

$$r_i(t) - \lambda_0(t) = \sum_{j=1}^{10} b_{ij}\lambda_j(t) + \sum_{j=1}^{10} b_{ij} F_j(t) + b_{ik}\lambda_k(t)\hat{F}_k(t) + u_i(t) \quad (3)$$

In the above specification $r_i(t)$ is the return on ith stock market index in period t (i=1,2,…,10 excluding the return on overall stock price index); λ_0 (t) is the return on a risk free asset in period t (measured by treasury bills rate); b_{ij} is the sensivity of index i to factor j; $\lambda_j(t)$ can be interpreted as the risk premium associated with the pervasive influence of factor j on all the indices; $F_j(t)$ is the shock or unanticipated realization of factor j in period t; $\hat{F}_k$ (t) is the estimated residual market factor (RMF) designed to capture the effect of any omitted variables. The RMF is estimated as the residuals from regression of the overall stock market index of the KSE against all the observable factors and $u_i(t)$ is the idiosyncratic disturbance of index i in period t. In this study j includes 10 factors including monthly GDP (Y), industrial production (Q), the money supply (M), price level (WP), trade deficit (TD), exchange rate (ER), openness of the economy (O), inter bank call money rate (CR), term structure of interest rate (TS) and the size or market capitalization of each sector of the stock market (S^i).

McElory and Burmeister (1988) estimate (3) with no time subscript for λ_j because the risk premia are assumed to be constant over time. Although in this study equation (3) is interpreted as an APT pricing equation, Chamberlain (1988) has shown that if the market portfolio is well diversified then this equation (3) can also be interpreted as Merton's (1973) Intertemporal Capital Asset Pricing Model (ICAPM). In Chamberlain (1988) framework the two pricing models are not testably distinct.

Theoretical work by Merton (1973) and Cox, Ingersoll and Ross (1985) relates the risk premium of factor j to its volatility and constant proportionality factor. Therefore, to complete the asset-pricing model the study uses the relationship proposed by Koutoulas and Kryzanowski (1996):

$$\lambda_j(t) = a_j + R_j \sigma_j^2 \ (t) \ (4)$$

where, R_j is a proportionality coefficient; $\sigma_j^2(t)$ is the conditional variance of factor j; and a_j is a parameter.[1] Since Merton (1980) examines the single factor model for which no state dependencies exist, Merton interprets R as a measure of relative risk aversion. If the conditional volatilities of economic and financial factors change over time, then the risk premia will be time varying. Substituting equation (4) into equation (3), rearranging, and letting $c_i = \sum_{j=1}^{k} b_{ij} a_j$ yields the following intertemporal asset pricing model:

$$r_i - \lambda_0(t) = c_i + \sum_{j=1}^{10} R_j b_{ij} \sigma_j^2 \ (t) + b_{ik} R_K \sigma_k^2 \ (t) + \sum_{J=1}^{10} b_{ij} F_j(t) + \hat{F}_K \ (t) + u_i(t) \ (5)$$

where u_i (t) is normally and independently distributed.

Let X^j denotes the jth macroeconomic or financial variable or factor included in the study. Using the methodology of Davidian and Caroll (1987) the innovations F_j (t) of the macroeconomic and financial variables are obtained as estimated residuals from the following equation:

$$(X^j)_t = E_t[(X^j)_t / I_{t-1}] + \varepsilon_{1,t}^{x^j} = \alpha_1(H)(X^j)_t + \sum_{m=1}^{12} \alpha_m \ SD_{m,t} + \varepsilon_{1,t}^{x^j} \quad (6)$$

where X^j is the j th variable α_1 (H) is a 12-th order polynomial in the lag operator H and SD_m are the monthly dummy variables to capture the seasonal variation in the mean of a variable. Equation (6) shows that the expected value of jth variable is determined by regressing the variable on monthly dummies and its own lags and $\varepsilon_{1,t}^{x^j}$ is the residual error term. This equation is initially estimated with the general form specified above, and then through stepwise backward elimination process its insignificant components are eliminated.

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[1] The system of equations described by (4) is a special form of the equilibrium conditions derived from a portfolio optimization problem where individuals choose a consumption withdrawal plan and an optimal portfolio in order to maximize the discounted expected value of utility of future consumption (which is a function of wealth and the current state of nature). If state dependencies are ignored, R is independent of j [as shown in Roll and Ross (1980)]. It follows that R=R_j for all j, and that R can be interpreted as a measure of relative risk aversion . Otherwise R depends on j, and cannot be interpreted as a measure of relative risk aversion.

Again using the methodology of Davidian and Caroll their variances are obtained as follows:

$$\sigma^2[F_j(t)] = \sum_{m=1}^{12} \alpha_m D_m(t) + \sum_{m=1}^{12} \theta_m \sigma^2[F_j(t-m)] + w_j(t) \quad (7)$$

where $\sigma^2[F_j(t)] = \frac{\pi}{2} F_j(t)^2$ is the unconditional variance of factor j at time t. Since $F_j(t)^2$ are single-point variance estimates, they have to be adjusted by the term *(π/2)* as suggested by Dan Nelson. This correction has also been used by Schwert (1989) and Koutoulas and Kryzanowski (1996). Equation (7) is initially estimated in its general form specified above and then through the backward elimination process its statistically insignificant components are eliminated.

Two separate tests to determine whether or not mean monthly conditional volatilities are jointly equal to zero and whether or not mean monthly conditional volatilities are equal across different months can also be performed. To do so $\sigma^2[\hat{F}_j(t)]$ is regressed on 12 months dummies as follows:

$$\sigma^2[\hat{F}_j(t)] = \sum_{m=1}^{12} \alpha_m D_m(t) + z_j(t) \quad (8)$$

where δ_m estimates the average conditional volatility for month *m*. An F-statistic under the null hypothesis of $\delta_1 = \delta_2 = \delta_3 = \ldots = \delta_{12} = 0$ indicates whether the conditional variances are on average jointly equal to zero. Another F-statistics under the null hypothesis of $\delta_1 = \delta_2 = \delta_3 = \ldots = \delta_{12} = \delta$ determines whether the conditional volatilities are on average stable from month to month.

Pagan (1984,1986); McAleer and McKenzie (1991) and Oxely and McAleer (1993) have pointed out econometric issues that arise in the analysis of regressions with generated regressors due to non-zero cross equation covariances. Specifically, the procedure of employing a two-stage estimation process to first estimate conditional volatilities and then model their interrelationships yields inefficient estimates, introduces bias into a number of diagnostic test statistics and generates potentially invalid inferences. In order to appropriately account for non-zero cross-equation covariances, which arise from generated regressor problem, the extended APT model of each sector as represented by equation (5) is estimated jointly together with the other equations determining the innovations and conditional variances of all variables included in each model using the framework of non-linear seemingly unrelated regression (NSUR). The estimation strategy involves Zellner's iterative procedure. The vector X in this model is given by:

$$X = [Y, Q, M, WP, TD, ER, O, TS, CR, S^i, RMF]$$

The final model for each industrial sector of KSE comprises 23 equations. First 11 equations of means of variables, mentioned in vector X, are given by equation (6), while next 11 equations for conditional variances of these variables are given by equation (7). The last equation is given by equation (5) for each sector of KSE. This equation links the excess returns on index i to conditional volatilities and innovations of financial and economic variables mentioned in vector X.

4. Data and Results

The data used for this study include monthly stock prices for the period July 1985 to July 2002, which makes a total of 204 observations. In total, ten mutually exclusive sectoral indices of stock prices are examined statistically. These ten sectors are: Cotton and Textile, Chemicals and Pharmaceuticals, Engineering, Sugar and Allied, Paper and Board, Cement, Fuel and Energy, Transport and Communication, Banks and Other Financial Institutions and Miscellaneous.

Other economic and financial variables, that can potentially influence the stock market are: the level of overall economic activity measured by gross domestic product (Y), the inter bank call money rate (CR), general price level (WP), the level of activity in the manufacturing sector (Q), the money supply (M), the term structure of interest rates (TS), the exchange rate (ER), the trade deficit (TD), the openness of the economy (O) measured by the ratio of the sum of exports and imports to GDP and the market capitalization (S). Table 1 contains a detailed description of all variables used in the analysis.

Data on stock price indices and all other variables except GDP, government bonds rate and treasury bills rate are obtained from State Bank of Pakistan (2003). The yearly GDP data are taken from the Government of Pakistan (2003) and split into monthly values using the exponential interpolation procedure and imposing continuity restrictions [See Chow and Lin (1971)].

Data on government bond rate is taken from International Monetary Fund (2003). Data on treasury bills rate are taken from the official files of the State Bank of Pakistan, Karachi, as the information was not available from the published sources. The treasury bills have short-term maturity and the rate of return is fixed. Therefore, treasury bills rate is an appropriate measure of risk free interest rate to be compared with returns on other assets.

As a first step of estimation, unit root tests are applied to all economic and financial variables to check their stationarity. In particular ADF (Augmented Dickey Fuller) tests are carried out for each variable by alternatively introducing an intercept, trend and intercept and no trend or intercept in the testing equation with alternative lags from zero to four [See Enders (2004) for details]. All the variables excluding openness, call rate and term structure of interest rates are found to be non-stationary. Then the same test is performed on the logarithms and first logarithmic first difference of each of the no stationary variable. The logarithms of each of these variables are also found to be no stationary, while their first logarithmic first differences are found to be stationary. Therefore the study uses growth rates of GDP, industrial production, money supply, price level, exchange rate, trade deficit, market capitalization and stock price indices, while it uses the levels of openness, inter bank call rate and term the structure variable. Using the procedure defined in equation (6) and (7) he innovations and conditional volatilities of economic and financial variables are estimated.

The residual market factor (RMF) that captures the effects of unobserved common shocks to all returns is estimated by using the procedure suggested by Koutoulas and Kryzanowski (1996). The overall KSE index is regressed against all the observable factors included in the study and residuals obtained from this equation are used as the residual market factor. The stationarity of the variances is tested by applying ADF tests. All these conditional variances are found to be stationary. In order to test the differences in monthly variances, the conditional variance of each variable is regressed against twelve monthly dummies without a constant term as mentioned by equation (8). These results are presented in Table 2.

The F_1 statistics, which test the null hypothesis that the conditional variances are jointly equal to zero, is highly significant. Therefore the null hypothesis is strongly rejected. The F_2 statistics, which test the null hypothesis of no difference between the mean monthly conditional variances for each variable, is highly significant in all the cases. Therefore the null hypothesis is strongly rejected. This indicates a strong seasonal deterministic variation (from month to month) of the conditional volatilities. In turn, based on equation (4), this implies a time-variation in risk premia. Although the conditional variances are different from month to month, the seasonality cannot be attributed to any particular month. In other words the data does not show evidence on the so-called 'January effect' or the like.

In the specification of our final model, first eleven equations are obtained from equation (6) by regressing each variable in vector X on monthly dummies and its own lags. Equation (7) provides the next eleven equations of conditional variances of included factors. The last equation is given by equation (5) in which the dependent variable is excess monthly return and it is an APT model extended by allowing the risk premia associated with the pervasive influence of a factor to vary over time. Ten such models are estimated for ten industrial sectors of KSE. Each model is estimated by using nonlinear seemingly unrelated regression (NLSUR) technique. Table 3 shows the estimates of factor sensitivity coefficients and the mean of the constant portion of the factor risk premia, obtained from these ten models.

The estimates of the mean of constant portion of the factor risk premia *(c)* are significant in most of the sectors. The presence of significant constant portion of risk premia (i.e., a_j) indicates that the level of risk premium cannot be fully explained by the APT model considered in this study; the systematic effect of excluded factors is non-zero.

The sensitivity coefficients for GDP and industrial production are in general significant with the negative signs. This shows that a shock in real sector of the economy adversely affects the stock market activity. Any real shock affects both the nominal and real components of asset returns and hence makes hedging against such a risk a difficult task. So, real sector's shocks adversely affect the market sentiments.

It follows from the results that the sensitivity of stock returns to unanticipated shocks in money supply is generally significant and positive. A shock in money supply indicates the liquidity risk, forcing investors to move from long-term assets to short-term assets. By providing an active market for existing corporate securities, the stock market is also able to fulfill the liquidity needs of surplus units. Hence the increase in liquidity risk makes stock assets more attractive.

The estimates indicate that an inflationary shock has a positive effect on excess returns. An inflationary shock in general has two effects for any investor. Firstly it makes liquidity unstable and secondly, the whole financial wealth becomes unstable from an investor's point of view. Investors will try to avoid pledging their wealth into long-term assets and prefer short- term assets to maneuver the risk more easily. The stocks are in general more liquid and their prices are determined on spot basis so their nominal returns partially adjust on daily basis, making them less risky and hence more attractive with respect to liquidity risk.

Regarding the effect of shocks in the growth rates of trade deficit and exchange rate they have significant adverse effects mostly in traded sectors like Cotton and Textile, Fuel and Energy and Banks and Other Financial Institutions.

Coming now to shocks in openness, its sensitivity coefficient estimates are highly significant with positive signs. This indicates that a shock in openness, indicating increased exposure to external real and financial markets, positively affects the stock returns.

The sensitivity coefficient estimates for the term structure of interest rates and call rate are in general negative, implying that a shock in term structure or call rate adversely affects the stock returns. Risk premium on stocks depends on the differential risk i.e., the difference between risk on stocks and the risk related to other assets. Thus shocks in either the term structure or call rate imply that the assets other than stocks become more risky, indicating a decrease in the differential risk and hence a reduction in risk premium associated with stocks.

The residual market factor's sensitivity coefficients are highly significant with positive signs, indicating that unobserved common shocks to all returns have a positive effect on stock returns.

Regarding the effect of shocks in size, its sensitivity coefficients are generally insignificant with the exception of four sectors. The positive sign of its sensitivity coefficient in three bigger sectors (i.e., Transport, Communication, and Banks beside other Financial Institutions and

Miscellaneous) lacks general interpretation. Since the market is relatively thin, it lacks safeguards that characterize equity market in industrial countries and involves inside trading activity. This may be due to the inadequate availability of pertinent information to investors for making investment decisions.

The estimates of proportionality coefficients are given in Table 4. These coefficients [R_js in equation (4)] represent the variation in risk premia caused by an increase in the variance of the relevant macroeconomic or financial factors. The results show that the volatility in factors that can be predicted has in general an insignificant effect on risk premia. Most of these proportionality coefficients are insignificant, but wherever significant, these have negative sign indicating a fall in risk premium with increase in predictable risk. Since, risk premium is a reward for tacking risk while holding stock market assets, if the predictable risk increases, it reduces the uncertainty of shocks. Therefore the effect of risk on excess returns, which measures the risk premium, should decline with the increase in predictable risk. In sensitive sectors (Fuel and Energy, Banks and Other Financial Institutions and the Miscellaneous sector) predictability matters more. The general insignificance of proportionality coefficients implies that the risk premia on most of the factors are constant.

5. Conclusion

The purpose of this study has been to contribute to the literature on the stock market of Pakistan by examining the exposure of KSE (Karachi stock Exchange) to economic and financial factors. The study is based on ten industrial sectors of KSE. It employs low frequency monthly data on stock market returns, GDP, industrial production, the inter bank call money rate, the term structure of interest rates, money supply, exchange rate, trade deficit, openness, inflation and market capitalization over the period July 1985 to July 2002.

To see the relationship of stock returns with economic and financial variables the study utilized an extended version of McElory and Burmeister's (1988) APT (Arbitrage Pricing Theory) model as proposed in Koutoulas and Kryzanowski (1996). The study has been innovative in terms of its estimation procedure employed to overcome the generated regressors problem, which yields inefficient estimates, introduces biases to a number of diagnostic test statistics and generates potentially invalid inferences. This problem has been overcome in the model by estimating the non-linear APT equation together with the equations determining the innovations and conditional volatilities of all variables included in each model in a framework of non-linear seemingly unrelated regression model. The estimation technique involves Zellner's iterative procedure.

The general conclusion of the study is that the stock prices in Pakistan are mostly influenced by the financial and economic indicators included in the study. This indicates that the day to day transactions in stock market may be based on perceptions but there does exist an underlying relationship between stock market activities and other economic and financial indicators that determines stock market trends in medium to long run.

The shocks or unanticipated realizations of economic and financial variables are found to be the significant determinants of movements in stock returns. The results also imply that the volatility in economic and financial factors that can be predicted has in general an insignificant effect on risk premium. Moreover it also follows from the results that the level of risk premium can't be fully explained by the APT model considered in the study.

The shocks in real sector's activity, which are measured by GDP and industrial production, are observed to have adverse effects on market sentiments. The exposure to external real and financial market shocks is observed to make the stock market more attractive. Shocks in exchange rate and trade deficit explain the stock return behavior mostly in the traded sector. Furthermore by providing an active market for existing corporate securities, KSE seems to be able to fulfill the liquidity needs of surplus units in the face of liquidity or inflationary shocks. The unexpected realizations of inter bank call money rate or the term structure of interest rates imply that the assets other than stocks become more risky, indicating a decrease in differential risk and hence corresponding reduction in the risk premium associated with the differential risk. Our results are inconclusive with reference to the anomaly of size.

Table 1 Description of variables

Notation	*Description*	*Source*
P^i	*i* th index of stock prices, where i= 1, 2, 3,……11. Each index is re-based to 1980-81.	Government of Pakistan
Y	The gross domestic product measured in million of Rupees.	State Bank of Pakistan
Q	The quantum index of manufacturing, re-based to 1980-81	State Bank of Pakistan
WP	The wholesale price index re-based to 1980-81	State Bank of Pakistan
M	Total monetary assets consisting of currency in circulation, scheduled banks demand deposits, scheduled bank's time deposits and other deposits with SBP, measured in million of Rs.	State Bank of Pakistan
CR	The inter bank call money rate.	State Bank of Pakistan
ER	The exchange rate defined as rupees per dollar	State Bank of Pakistan
TD	The trade deficit given by the monthly difference between imports and exports, measured in million of Rupees.	State Bank of Pakistan
TS	The term structure of interest rate given by government bond rate minus treasury bills rate.	International Monetary Fund and State Bank of Pakistan
O	Openness of the economy measured by ratio of the sum of exports and imports to GDP.	Government of Pakistan and State Bank of Pakistan
S^i	Market capitalization related to *i*th index where *i*=l, 2,……, 11. It is market value of all listed companies at the end of the month. The market value of a company is the share price times the number of shares outstanding.	State Bank of Pakistan

Table 2: Seasonality in the Conditional Variances of Innovations of Financial and Economic Variables

Variable	***Seasonal Effects***												F_1	F_2
	Jan	***Feb***	***March***	***April***	***May***	***June***	***July***	***Aug***	***Sep***	***Oct***	***Nov***	***Dee***		
CVIGY	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0067	0.0012	46.94	46.11
	(1.3 8)*	(1. 06)	(0.96)	(0.91)	(0.91)	(0.81)	(0.82)	(0.86)	(0.88)	(0.85)	(25.04)	(4.48)		
CVIGQ	0.0039	0.0031	0.0080	0.0075	0.0037	0.0033	0.0038	0.0023	0.0028	0.0032	0.0030	0.0099	17.83	16.97
	(6.39)	(5.18)	(13.63)	(12.78)	(6.39)	(5.68)	(6.34)	(3.90)	(4.67)	(5.29)	(4.92)	(16.44)		
CVIGM	0.0001	0.0002	0.0002	0.0005	0.0008	0.0013	0.0004	0.0008	0.0002	0.0002	0.0002	0.0002	24.32	23.42
	(1.81)	(2.56)	(2.22)	(7.0 I)	(11.36)	(17.27)	(5.46)	(10.24)	(3.23)	(3.06)	(2.37)	(2.42)		
CVIWP	0.013	0.012	0.010	0.010	0.011	0.009	0.011	0.011	0.011	0.010	0.038	0.021	11.99	11.85
	(5.53)	(4.98)	(4.30)	(4.29)	(4.46)	(3.66)	(4.29)	(4.35)	(4.46)	(4.02)	(15.88)	(8.67)		
CVIGTD	0.290	0.298	0.406	0.308	0.293	0.320	0.296	0.287	0.299	0.299	0.303	1. 703	170.6	177.6
	(11.98)	(12.32)	(16.78)	(12.73)	(12.11)	(13.22)	(11.88)	(11.52)	(11.97)	(12.38)	(12.51)	(17.36)		
CVIGER	0.0001	0.0010	0.0002	0.0001	0.0012	0.0001	0.0008	0.0002	0.0001	0.0013	0.0003	0.0001	40.11	41.92
	(2.04)	(20.45)	(4.54)	(2.19)	(23.73)	(2.59)	(16.07)	(3.92)	(1.93)	(26.60)	(5.23)	(1.91)		
CVITS	0.646	0.784	0.772	1.033	1.165	0.701	1.405	0.713	1.305	0.750	0.594	0.703	2.36	4.26
	(3.54)	(4.29)	(4.23)	(5.66)	(6.38)	(3.96)	(7.70)	(3.91)	(7. 15)	(4.11)	(3.26)	(3.85)		
CVICR	0.6013	0.4115	0.6226	1.1324	1.4015	0.5487	1.4756	0.6195	1.3 196	0.8700	0.5500	0.7146	4.81	4.49
	(3.3 9)	(2.32)	(3.51)	(6.39)	(7.90)	(3.09)	(9.32)	(3.49)	(7.44)	(4.91)	(3.10)	(4.03)		
CVIRMF	0.0029	0.0009	0.0013	0.0010	0.0015	0.0009	0.0010	0.0007	0.0149	0.0012	0.0059	0.0012	7.77	7.25
	(1.94)	(0.57)	(0.86)	(0.67)	(1.01)	(0.61)	(0.64)	(0.45)	(9.83)	(0.77)	(3.87)	(0.79)		
CVIGS$_1$	0.0047	0.0055	0.0037	0.0050	0.0053	0.0051	0.0116	0.0059	0.0054	0.0044	0.0247	0.0046	18.78	17.19
	(3.34)	(3.86)	(2.63)	(3.51)	(3.76)	(3.57)	(8.18)	(4.17)	(3.84)	(3.14)	(17.45)	(3.24)		
CVIGS$_2$	0.0067	0.0106	0.0344	0.0073	0.0079	0.0103	0.0123	0.0070	0.0083	0.0098	0.0091	0.0066	12.90	12.34
	(3.08)	(4.89)	(15.84)	(3.36)	(3.64)	(4.87)	(5.68)	(3.22)	(3.82)	(4.51)	(4.19)	(3.02)		

Note: The description of variables is given at the end of the table.

Table 2: (continued) Seasonality in the Conditional Variances of Innovations of Financial and Economic Variables

Variable	***Seasonal Effects***												F_1	F_2
	Jan	*Feb*	*March*	*April*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*		
$CVIGS_3$	0.0046	0.0058	0.0051	0.0048	0.0055	0.0046	0.0351	0.0089	0.0056	0.0050	0.0047	0.0056	44.42	41.38
	(3.45)	(4.32)	(3.77)	(3.59)	(4.07)	(3.42)	(26.16)	(6.60)	(4.20)	(3.75)	(3.53)	(4.17)		
$CVIGS_4$	0.0023	0.0077	0.0061	0.0027	0.0027	0.0025	0.0067	0.0023	0.0028	0.0019	0.0054	0.0094	39.24	36.67
	(5.40)	(18.20)	(14.24)	(6.34)	(6.30)	(5.81)	(15.80)	(5.33)	(6.61)	(4.51)	(12.65)	(22.21)		
$CVIGS_5$	0.0071	0.0075	0.0042	0.0045	0.0042	0.0050	0.0083	0.0068	0.0084	0.0025	0.0092	0.0072	5.48	5.14
	(7.68)	(8.12)	(4.49)	(4.83)	(4.58)	(5.44)	(8.94)	(7.32)	(9.12)	(2.69)	(9.96)	(7.77)		
$CVIGS_6$	0.0150	0.0054	0.0133	0.0131	0.0155	0.0148	0.0130	0.0148	0.0152	0.0153	0.0140	0.0137	4.15	3.92
	(10.83)	(3.91)	(9.63)	(9.48)	(11.25)	(11.08)	(9.41)	(10.71)	(11.02)	(11.08)	(10.16)	(9.90)		
$CVIGS_7$	0.0171	0.0132	0.0145	0.0105	0.0289	0.0215	0.0122	0.0392	0.0242	0.0169	0.0094	0.0184	2.16	2.07
	(2.92)	(2.25)	(2.47)	(1.79)	(4.93)	(3.66)	(2.02)	(6.4 7)	(4.12)	(2.88)	(1.60)	(3.13)		
$CVIGS_8$	0.0115	0.0123	0.0050	0.0044	0.0104	0.0130	0.0117	0.0031	0.0188	0.0083	0.0185	0.3003	59.09	48.2
	(2.71)	(2.96)	(0.29)	(1.51)	(1.48)	(2.11)	(1.55)	(1.14)	(2.77)	(1.06)	(2.70)	(4.01)		
$CVIGS_9$	0.0107	0.0241	0.0068	0.0101	0.0096	0.0253	0.0841	0.0079	0.0142	0.0094	0.0392	0.0057	4.56	4.36
	(1.00)	(2.25)	(0.66)	(0.97)	(0.92)	(2.43)	(7.85)	(0.73)	(1.33)	(0.88)	(3.65)	(0.54)		
$CVIGS_{10}$	0.0058	0.0011	0.0043	0.0036	0.0030	0.0063	0.0062	0.0028	0.0022	0.0067	0.0055	0.0024	15.98	14.99
	(11.73)	(2.18)	(8.69)	(7.21)	(6.01)	(12.78)	(12.62)	(5.63)	(4.37)	(13.58)	(11.11)	(4.81)		

The prefix CVI denotes the conditional variance of innovations of a variable and CVIG is the conditional variance of innovations of the growth rate of a variable. Y: Gross Domestic Product, Q: industrial production, M: money supply, WP: rate of inflation, TD: trade deficit, ER: exchange rate, O; openness, TS: term structure of interest rate, CR: call rate, RMF: residual market factor, S: market capitalization, its subscript 1 is for Cotton and Textile, 2 for Chemicals and Pharmaceuticals, 3 for Engineering 4 for Sugar and Allied, 5 for Paper and Board, 6 for Cement, 7 for Fuel and Energy, 8 for Transport and Communication, 9 for Insurance and Finance, 10 Miscellaneous and 11 for the overall market of KSE.

F_1 is the value of F - statistic for the hypothesis that conditional variances are jointly equal to zero.

F_2: is the value of F - statistic for the hypothesis that conditional variances are equal across months.

The t-statistics are given in parentheses.

Table 3: The Estimates of Factor Sensitivities and the Mean of the Constant Portion of the Factor Risk Premia
(The dependent variable is the excess return)

Sector	$\hat{c}$	$\hat{b}_{iGQ}$	$\hat{b}_{iGY}$	$\hat{b}_{iGM}$	$\hat{b}_{iWP}$	$\hat{b}_{iGTD}$	$\hat{b}_{iGER}$	$\hat{b}_{iO}$	$\hat{b}_{iTS}$	$\hat{b}_{iGS}$	$\hat{b}_{iCR}$	$\hat{b}_{iRMF}$
Cotton and Textile	-0.095	-0.201	-1.911	1.215	0.895	-0.019	-0.888	1.096	0.003	0.152	-0.017	0.54
	(-4.34)*	(-1.86)**	(-3.62)*	(3.74)*	(4.61)*	(-1.65)**	(-3.31)*	(2.00)*	(0.65)	(1.35)	(-2.33)*	(5.30)*
Chemicals and	-0.049	1.281	-2.172	0.675	0.991	-0.022	-0.156	-0.956	0.007	-0.028	-0.022	0.366
Pharmaceuticals	(-2.04)*	0.12	(-4.04)*	(2.02)*	(5.09)*	(-1.73)**	(-0.577)	(-6.04)*	(1.41)	(-0.38)	(-4.13)*	(3.69)*
Engineering	-0.093	-0.456	-1.327	0.632	0.811	-0.033	-0.169	-0.912	0.006	-0.035	-0.019	0.341
	(-3.31)*	(-1.68)**	(-2.04)*	(2.01)*	(2.08)*	(-1.22)	(-0.617)	(-4.21)*	(1.32)	(-0.487)	(-2.41)*	(2.10)*
Sugar and Allied	-0.058	-1.541	-1.563	0.987	0.81	-0.012	-0.821	-0.878	0.003	-0.14	-0.015	0.329
	(-2.45)*	(-1.69)**	(-2.94)*	(2.36)*	(3.32)*	(-0.76)	(-2.42)*	(-12.08)*	(0.48)	(-0.94)	(-2.31)*	(2.49)*
Paper and Board	-0.071	0.026	-1.176	1.4	1.932	-0.011	-0.294	-1.326	-0.012	0.128	-0.002	1.945
	(-2.94)*	(0.464)	(-2.63)*	(4.09)*	(9.54)*	(-0.82)	(-1.04)	(-2.21)*	(-2.34)*	(1.22)	(-0.43)	(7.79)*
Cement	-0.041	-0.679	-1.393	0.431	0.754	0.018	-0.563	-1.443	-0.035	0.127	-0.005	0.173
	(-1.29)	(-4.20)*	(-2.19)*	(0.89)	(2.63)*	(1.06)	(-1.41)	(-6.82)*	(-4.63)*	(1.09)	(-0.56)	(1.2)
Fuel and Energy	-0.001	-0.0527	-2.341	0.211	1.23	-0.027	-2.233	-1.869	-0.017	-0.207	-0.04	0.713
	(-0.031)	(-1.71)**	(-3.55)*	(0.413)	(4.11)*	(-2.42)*	(-5.32)*	(-2.05)*	(-2.13)*	(-2.34)*	(-4.89)*	(4.66)*
Transport and	-0.054	-0.336	-1.92	2.045	1.242	0.005	-0.254	-0.918	-0.018	0.066	-0.02	0.463
Communication	(-1.98)*	(-2.09)*	(-3.10)*	(4.34)*	(4.42)*	(0.255)	(-0.649)	(-10.96)*	(-2.45)*	(1.75)**	(-2.65)*	(3.31)*
Banks and Other	0.058	-0.735	-2.337	1.868	3.684	-0.038	-1.063	-0.648	-0.016	0.376	-0.037	0.001
Financial Institutions	1.38	(-2.96)*	(-2.45)*	(2.53)*	(8.31)*	(-1.66)**	(-1.72)**	(-4.94)*	(-1.93)**	(3.23)*	(-3.16)*	(0.006)
Miscellaneous	-0.051	-0.131	-1.499	0.759	1.674	0.017	-0.822	-1.469	-0.032	0.286	-0.015	1.295
	(-2.01)*	-1.04	(-3.03)*	(2.01)*	(7.65)*	(1.18)	(-2.64)*	(-2.18)*	(-5.40)*	(2.14)*	(-2.43)*	(10.12)*

* Significant at 5% level.
* * Significant at 10% level.

GQ: Growth rate of industrial production, GY: Growth rate of GDP, GM: Growth rate of money supply, WP: The rate of inflation, GTD: Growth rate of trade deficit, GER: Growth rate of exchange rate, O: openness of the economy, TS: Term structure of interest rates, CR: Inter bank call money rate GS: Growth rate of size or market capitalization, RMF: Residual market factor.

Table 4: The Estimates of Risk Premium Proportionality Coefficients (The dependent variable is the excess return)

Sector	$\hat{R}_{iGQ}$	$\hat{R}_{iGY}$	$\hat{R}_{iGM}$	$\hat{R}_{iWP}$	$\hat{R}_{iGTD}$	$\hat{R}_{iGER}$	$\hat{R}_{iO}$	$\hat{R}_{iTS}$	$\hat{R}_{iGS}$	$\hat{R}_{iCR}$	$\hat{R}_{iRMF}$
Cotton and Textile	10.80	-0.00008	1.647	-1.813	0.012	13.501	-0.257	-0.557	-1.723	0.101	5.255
	(0.061)	(-1.695)**	(0.177)	(-2.079)*	(0.717)	(0.900)	(-0.482)	(-0.683)	(-0.390)	(0.174)	(3.832)*
Chemicals and	1.181	0.00001	-1.351	-1.087	-0.197	-6.435	-0.476	-0.158	-4.274	-0.057	2.549
Pharmaceuticals	(0.249)	(0.251)	(-0.320)	(-1.698)**	(-0.320)	(-0.083)	(-0.782)	(-1.353)	(-0.388)	(-1.840)**	(1.672)**
Engineering	-1.209	-0.00002	-1.685	-0.316	-0.305	-6.219		-0.217	-1.988	-0.061	2.843
	(-1.344)	(-0.851)	(-0.233)	(-0.834)	(-0.551)	(-0.873)		(-1.043)	(-1.675)**	(-1.452)	(1.694)**
Sugar and Allied	-1.470	0.00002	-3.793	0.150	0.264	4.362	-0.071	-0.342	6.883	-0.046	4.830
	(-1.455)	(0.820)	(-1.968)**	(0.132)	(0.161)	(0.244)	(-0.088)	(-0.701)	(0.357)	(-0.627)	(1.760)**
Paper and Board	-3.229	-0.00002	-5.030	-1.244	1.487	-2.116	-0.301	-0.022	-1.936	0.374	0.980
	(-0.219)	(-0.358)	(-0.617)	(-3.044)*	(0.568)	(-0.491)	(-0.644)	(-0.294)	(-1.664)**	(0.349)	(1.704)**
Cement	4.337	-0.0003	-5.801	-2.549	0.303	10.637	0.362	-0.111	9.706	0.033	5.027
	(0.599)	(-0.706)	(-0.155)	(-1.692)**	(0.540)	(0.285)	(0.600)	(-2.786)*	(0.778)	(0.099)	(0.935)
Fuel and Energy	-9.468	-0.00006	-1.960	0.092	-0.240	-4.762	0.453	-0.147	-1.868	-0.060	3.255
	(-0.314)	(-1.940)**	(-0.416)	(0.098)	(-0.306)	(-0.588)	(0.921)	(-1.675)**	(-1.770)**	(-1.666)**	(2.182)*
Transport and	-1.962	-0.00004	-10.799	-2.559	-0.637	5.311	0.515	0.014	-0.169	-0.044	0.732
Communication	(-0.315)	(-1.784)**	(-1.729)**	(-2.805)*	(-0.104)	(0.45)	(0.563)	(0.191)	(-0.111)	(-0.668)	(0.077)
Banks and Other	0.741	-0.00008	-13.878	-1.346	1.547	-30.722	-1.014	-0.014	-1.498	-0.077	3.262
Financial Institutions	(0.156)	(-1.693)**	(-1.761)**	(-2.741)*	(1.003)	(-1.298)	(-0.543)	(-0.116)	(-2.771)*	(-1.996)*	(2.467)*
Miscellaneous	-2.097	0.0003	4.621	-0.656	-2.073	-26.432	-0.088	-0.029	-16.561	-0.099	5.989
	(-0.996)	(0.702)	(0.267)	(-1.804)**	(-1.122)	(-1.503)	(-0.189)	(-0.835)	(-1.816)**	(-1.809)**	(5.540)*

* Significant at 5% level.

** Significant at 10% level.

GQ: Growth rate of industrial production, GY: Growth rate of GDP, GM: Growth rate of money supply, WP: Rate of inflation, GTD: Growth rate of trade deficit, GER: Growth rate of exchange rate, O: openness of the economy, TS: Term structure of interest rates, CR: Inter bank call money rate GS: G growth rate of size or market capitalization, RMF: Residual market factor.

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