ISSN 1811-5438

THE LAHORE JOURNAL OF ECONOMICS

Lahore School of Economics

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Volume 14, No.1 **Jan-June, 2009**

THE LAHORE JOURNAL OF ECONOMICS

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Publisher : Lahore School of Economics, Lahore, Pakistan.

Correspondence relating to subscriptions and changes of address should be sent to *The Lahore Journal of Economics*, 105-C-2, Gulberg III, Lahore - 54660 – Pakistan

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14 2009

THE LAHORE JOURNAL OF ECONOMICS

Contents Vol. 14, No.1, 2009

Trade Liberalization and the Lead Role of Human Capital and Job Attributes in Wage Determination: The Case of Pakistan's Labor Market
Bushra Yasmin 1

The Impact of Socio-Economic and Demographic Variables on Poverty: A Village Study
Imran Sharif Chaudhry, Shahnawaz Malik and Abo ul Hassan 39

Economic Value of Irrigation Water: Evidence from a Punjab Canal
Ijaz Hussain, Maqbool H. Sial, Zakir Hussain, and Waqar Akram 69

Cointegration and Causality: An Application to Major Mango Markets in Pakistan
Abdul Ghafoor, Khalid Mustafa, Khalid Mushtaq and Abedullah 85

An Empirical Investigation of the Causal Relationship among Monetary Variables and Equity Market Returns
Arshad Hasan and M. Tariq Javed 115

The Impact of Corporate Governance on the Cost of Equity: Empirical Evidence from Pakistani Listed Companies
Syed Zulfiqar Ali Shah and Safdar Ali Butt 139

Book Review:

Banker to the Poor, The Story of Grameen Bank
Nina Gera 173

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Printed by Lahore School of Economics Press

The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 1-37

Trade Liberalization and the Lead Role of Human Capital and Job Attributes in Wage Determination: The Case of Pakistan's Labor Market

Bushra Yasmin*

Abstract

This study analyzes the role of human capital and job attributes, i.e., supply-side determinants, in determining wages in a period of trade liberalization. Using the Mincerian earning function and based on data from the Labor Force Surveys, we construct a model to estimate various wage determinants and compute the rates of return to different educational qualifications and relative occupational wage shares for the years 2005/06 and 1990/91. The estimated earning functions for 1990/91 and 2005/06 are compared to investigate whether individual characteristics—such as gender, job location, nature of job, educational qualifications, and different occupations—cause the wage gap to widen or contract under conditions of trade liberalization. The mean and quantile regression approach is used for estimation purposes. Our key findings postulate (i) an increasing gender pay gap, (ii) a higher wage premium to the highest educational qualification, and (iii) more or less stable relative wages for different occupations over time. In addition, wage dispersion across occupational groups appears more pronounced in 1990/91 than in 2005/06, implying a declining trend in the difference in wage distribution across occupations. Our findings suggest that trade liberalization cannot be presumed to pose a threat to the labor market in the wage context. However, exposing labor to an open market has not increased the productivity and skills of labor or helped reap the potential benefits of trade liberalization.

JEL Classification: F16, J31.

Keywords: Trade liberalization, wage determination, human capital, Pakistan.

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I. Introduction

Trade openness has been regarded as a key element of any development policy at the global level since the late 1970s. Openness, better explained as "trade liberalization" in this context, connotes a reduction in barriers to the movement of goods and services in international trade. Edwards (1993) describes a liberal trade regime as one in which all trade distortions, including import tariffs and export subsidies, are completely eliminated. The benefits of trade liberalization, if done collectively with other countries, multiply significantly, but the profitability of liberalization can only be confirmed by the proliferation of its positive effects on the economy. In this regard, the argument is generally in favor of trade liberalization in its role of leading the economy to a higher growth rate at the national and international level.

Trade liberalization is generally favored on the grounds of (i) facilitating economic growth—given its dynamic advantages of higher capacity utilization and more efficient investment—and (ii) promoting the performance of export growth and increasing productivity. As liberalization policies remove restrictions on trade between countries, producers have access to the inputs required to produce more efficiently, while new overseas markets are opened to exporters and opportunities are broadened for existing export industries. This liberalization is expected to reallocate resources according to comparative advantage while large-scale operations flourish, given greater economies of scale.

However, there are certain costs associated with trade liberalization, such as loss in tariff revenue, which accounts for 10 to 20% of government revenue in developing countries. A larger burden of domestic taxes—such as sales tax—to compensate for this loss and heavy reliance on borrowing to finance the fiscal deficit collectively raises the country's overall debt. This exacerbates the problem and has distortionary effects on the economy. Moreover, tariff reductions deprive a country's domestic industry of protection, leading to adverse effects on existing industries and the services sector. It is also commonly held that the gains from trade liberalization are not distributed uniformly among economies generally and within a country specifically.

Proponents of trade liberalization typically regard labor as one of its chief beneficiaries. According to standard trade theory, countries with an abundant labor supply reallocate resources toward labor-intensive goods, leading to an increase in demand for labor. Depending on the prevailing labor market conditions, the resulting increase in demand for labor

translates into some combination of an increase in employment and wages. While the logic of this argument is fairly compelling and is generally supported by the experience of the early liberalized and newly industrialized economies of East Asia (Hong Kong, Korea, Singapore, and Taiwan), more recent episodes of trade liberalization appear not to have been associated with large improvements in prospects for the typical worker (Robbins 1996, Wood 1997).

Pakistan has a comparative advantage in three key areas: (i) agriculture, (ii) textiles, and (iii) services; an overwhelming proportion of workers in Pakistan are engaged in these sectors. In the standard trade theory context, we would expect openness to cause a significant boost in employment, production, and growth of the economy. On the labor demand side, trade liberalization might affect own-wage elasticities through at least three channels: (i) substitutability of inputs, (ii) product demand elasticities, and (iii) the degree of collusion in the industry. The importance of the labor-demand elasticity element with respect to trade was first emphasized by Rodrik (1997), who argued that strengthening competition in the goods market would increase the sensitivity of factor demand to shocks, and the increased competitiveness of output markets and greater access to foreign inputs would lead to a more elastic demand for labor. This would, in turn, bring about greater volatility in the labor market since bad shocks to output translate into a greater impact on wages and employment.

The modest but growing body of literature linking trade with labor provides weak evidence of employment effects. Labor reallocation is assumed to be limited in developing countries in the wake of trade liberalization due to labor market rigidities, and trade reforms can affect the labor market through wages rather than employment channels as proposed by Goldberg and Pavcnik (2004). However, no empirical evidence for Pakistan— using micro-level data and controlling for observable workers' characteristics—is yet available to verify this common belief. The literature linking trade with wage effects concentrates mostly on developed countries while the evidence for developing countries is limited and apt to yield mixed results.

Using micro-data from the Labor Force Surveys (LFS) for two years, 2005/06 and 1990/91, this study is an attempt to explore trade-labor links through the wage effects of trade liberalization, while controlling for observable workers' characteristics.[1] An augmented Mincerian earnings

[1] The data on wages was available from the Labor Force Survey of year 1990-91 onward hence this year as initial period of trade liberalization was selected to compare the results with the results of year 2005-06.

function is estimated for the years 1990/91 and 2005/06, and the estimated results are compared to verify whether any change in wage determination took place over this period from different perspectives, including gender gap, educational qualifications, job attributes, type of residence, and occupational choice. This, in turn, helps us measure wage inequality (widening or contracting wage gaps as a consequence of trade liberalization) among workers. The rate of return to different educational qualifications and relative wage shares among different occupations are also computed to allow deeper insight into trade-related changes in the wage premium. The econometric methodology applied is mean and quantile regression. The latter serves to analyze wage structure at different points of the conditional wage distribution: a recent approach not analyzed by any study in this framework.

The remaining study is organized as follows. Section II provides a brief literature review and historical overview of Pakistan's trade liberalization and labor market. Sections III and IV outline the model's specifications followed by econometric methodology. Section V details the data used. The last sections elaborate on the empirical results achieved, and conclude with some policy suggestions.

II. Historical Background

II.1 Literature on Wages and Trade

The main studies that examine the wage effects of trade liberalization based on micro–data while controlling for observable workers' characteristics and using wage regression models include: Gaston and Trefler (1994), Hanson and Harrison (1999), Beyer, Rojas, and Vergara (1999), Feliciano (2001), Goldberg and Pavcnik (2004), Hasan and Chen (2004), and Dutta (2007). Wage premiums are related to earning function estimates that include controls for various observable workers' characteristics such as sex, age, experience, location, and education attained. A two-step procedure is used to find such a link. The wage premium is, in turn, related to trade policy, trade flows, and industry characteristics. Gaston and Trefler (1994) find that tariffs had a negative effect on relative wages in the US, while Feliciano (2001), Hasan and Chen (2003), and Pavcnik, et al (2004) find that, once industry fixed effects are controlled for, tariffs had no statistically significant effects in Mexico, the Philippines, and Brazil, respectively. Jean and Nicoletti (2002) find that tariffs had a significant positive impact on relative wages in the manufacturing industries of 12 OECD countries, including the US.

For Pakistan, there is a dearth of studies specifically devoted to finding out the changing role of the factors affecting wage determination and its linkage with the phases of trade liberalization. But a number of studies dealing only with wage determination using older years data sources including Labor Force Surveys (LFS) and Pakistan Integrated Household Survey (PIHS) are of Hyder and Reilly (2005), Shabbir (1994), Khan and Irfan (1985) and Haque (1984). These studies adopted different specifications with the background of Mincerian earnings function and found various individual workers' characteristics specifically gender, experience and education as major determinants of wages in Pakistan's labor market.

In general, the East Asian experience shows a reduction in wage inequality after openness strongly oriented toward exports. This is consistent with standard trade theory, which predicts that trade liberalization should benefit the locally abundant factor [Wood (1994) and (1999); Krueger (1983) and (1990)]. However, the generality of this outcome has been challenged by many studies. Robbins and Gindling (1999) investigate the changes in relative wages and in the supply and demand for skilled labor in Costa Rica before and after trade liberalization. They find that the skill premium rose after liberalization as a result of changes in the structure of labor demand. Beyer, et al (1999) use a time series approach and find that a long-term correlation exists between openness and wage inequality in Chile. Hanson and Harrison (1999) examine wage and employment changes in Mexico and find little variation in employment levels but a significant increase in skilled workers' relative wages. Likewise, Feliciano (2001) finds that the increase in returns to education in Mexico contributed to the rise of relative wages of skilled workers. Similarly, Green, et al (2001) find an increase in the returns to college education following trade liberalization and attribute this to rising relative demand for college-educated workers. Hence, the evidence on wage inequality linked to trade liberalization suggests an overall positive relationship between trade and wage inequality.

II.2 Trade Policy and Labor Market Implications: Pakistan's Perspective

This section provides a brief review of trade liberalization and labor policies adopted by different Pakistani governments over time.

Evolution of Trade Policy

A weak industrial base, dominant agricultural sector, lack of well-organized infrastructure, and macroeconomic and political instability characterize the early years of Pakistan's economy. During this time, Pakistan adopted a restrictive trade regime by imposing high tariff and non-

tariff barriers as a means to protect/promote industrialization. From 1953 to 1964, virtually all imports into Pakistan were regulated by some form of quantitative control.

The trade policy adopted by Pakistan after 1952 had three major components: (i) overvaluation of the Pakistan rupee relative to other countries, (ii) use of quantitative controls on imports to regulate the level and composition of imported goods, and (iii) a highly differentiated structure of tariffs on imports and export taxes on two principal agricultural exports, jute and cotton. This led to a particular type of import-substituting industrialization. There was no real export promotion policy until at least 1956, when an export promotion scheme, which covered 67 primary commodities and 58 manufacturing goods, was introduced, entitling exporters to import licenses for certain specific items to the extent of 25% and 40% on various categories of manufacturing goods and 15% on the export of raw materials (Ahmed 1984). The new trade policy in 1959 shifted toward indirect controls on imports and on the domestic price of other goods. During the 1960s, there was direct emphasis on the promotion of manufactured exports through the introduction of the Export Bonus Scheme 1959 (EBS)—a multiple exchange rate system. In addition, an import-liberalizing program was started in 1959.

In 1972, the Government took steps to abolish the import licensing system, multiple exchange rate system, and EBS; the import of luxury items was also banned. The most dramatic step taken was the devaluation of the rupee by 56% from PRs4.74 to USD1 to Rs11; after the US dollar was devalued in 1973, the rupee settled at a new exchange value of Rs9.90 to USD1, a rate that remained fixed for about 8 years. After the devaluation of the rupee, there was a considerable change in import policy. Exports grew by 38.4% and 24.7% in 1973/3 and 1973/74, respectively, as a result of devaluation. Later, the Government adopted a series of steps to liberalize the trade regime. The number of banned goods was reduced and most nontariff barriers, which had been imposed after the oil shock and foreign exchange stringency of the 1970s, were removed. Between 1977 and 1983, the number of items on the free list was increased and the procedure for importing commodities was streamlined. The Government negotiated a substantial move toward trade liberalization with the International Monetary Fund (IMF) and World Bank in the early 1980s.

Reductions in quantitative barriers continued during the 1980s and 1990s. Each year, at the time the budget and trade policy were finalized, measures aimed at trade liberalization were announced although tariff reforms were slow to be implemented. The fear of loss of revenue because

of tariff reforms by the Government was an important consideration in the implementation of these reforms. However, the pace of trade reforms had increased by 1988/89 (HDC 2001).

Although the trade regime in Pakistan experienced its most restrictive stage in the 1980s, the scope of nontariff barriers was significantly reduced and a negative import system adopted as part of the import regime in the early 1980s. Later, duties were eliminated on 100 commodity categories (mainly raw material and capital goods). Despite these measures, Pakistan's nominal tariff rates for manufacturing industries in 1986 were still among the highest in the world (Sayeed 1995). The most significant change was the formulation of a new trade policy in 1987. The salient features of this trade policy were as follows: (i) the number of tariff slabs was cut down to 10 from 17, (ii) a uniform sales tax of 12.5% replaced previous rates that varied across commodities, and (iii) maximum tariff rates were reduced to 125% from 225%. Economy-wide, the average tariff rate declined by 8 percentage points in 1987/88. The most important policy that affected exports was the delinking of the Pakistan rupee from the US dollar and the introduction of a flexible exchange rate system.

Under its first major structural adjustment program in 1988, the Government committed to making extensive changes in its trade regime. By 1993, a number of steps based on the structural adjustment program had been taken. In March 1993, import licenses were abolished for all goods except those on the negative and restricted list. The maximum tariff was reduced from 225% in 1988 to 70% in 1994/95. The country moved further toward trade liberalization by gradually decreasing import duties on consumer as well as capital goods. The maximum rate of tariff in 2000/01 was 30%, with the exception of automobiles and alcoholic beverages, which attracted higher rates of duty. Duty rates for the period 2000-2003 show that the decline in the duty rate on capital goods was higher than on consumer goods: duty rates on consumer goods declined by 8% while duty rates on capital goods declined by 11%. This was stated in the announcement of the trade policy for 2003/04: as part of the new multilateral trading system envisaged in the World Trade Organization (WTO) regime starting in 1995 and maturing in 2005, all quantitative restrictions on the export and import of textiles and clothing would be eliminated from 1 January 2005. The imports increased by 17.8%, because of higher imports of edible oils, increases in POL imports; an increase of 75% in machinery group imports (mainly of textile machinery, electrical machinery and agricultural machinery).

The tax and tariff policies in the 2004/05 trade policy have, in particular, been used to serve the national objective of bringing about an industrial turnaround to achieve macroeconomic goals. According to the trade policy for 2005/06, a rapid export growth strategy was introduced to facilitate a quantum jump in the level of exports, based on the following five pillars: (i) resort to trade diplomacy to increase market access, (ii) regional diversification of exports market, (iii) strengthening of trade promotion infrastructure, (iv) skill development, and (v) early provision of modern infrastructure.

Labor Policies in Pakistan

Since independence, five labor market policies have been announced by the Government in 1955, 1959, 1969, 1972, and 2002, laying down parameters for the growth of trade unionism, protection of workers' rights, settlement of industrial disputes, and redress of workers' grievances. Pakistan's Labor Policy 2002 is based on the International Labor Organization (ILO)'s core standards and provides an essential, but necessarily broad, framework for the future development of the country's labor protection system, with particular reference to industrial relations and some aspects of labor protection.

Historically, the 1960s and 1970s were a turbulent period in the history of industrial relations in Pakistan. Militant trade unions and equally intransigent management were locked in endless disputes and conflicts over pay and working conditions. Strikes, go-slows, lockouts, and litigation were the most distinctive features of employer-employee relations. The concept of employers and employees working together in close cooperation to ensure productivity, profitability and growth of businesses, and security of employment was largely nonexistent. There was no realization that job security and appropriate wages were critically important for profitability and the continued competitiveness of businesses. As a consequence, both the entrepreneur and labor suffered greatly. Perhaps labor suffered most on account of increasing unemployment and declining real wages as both public and private sector businesses increasingly resorted to cutbacks, relocation, closures, contract employment, and outsourcing in an effort to maintain profits and counter pressure from trade unions. The progressive globalization of the economy is bringing forth even more formidable challenges and pressures. Today, however, a different scenario is emerging. Sobered by the negative experiences of adversarial industrial relations over past decades, trade unions are increasingly discarding militancy while employers are recognizing the need and benefits of co-opting labor as partners-in-productivity. Both employers and trade unions are progressively

becoming involved in bilateral dialogue with the growing realization that the common interest of both employers and employees is best served by securing business profitability and growth. A new labor policy was formulated (as the first after 1972) in 2002.

The labor policy 2002 makes specific reference to a range of industrial relations issues, including the strengthening of bilateralism and social dialogue, the promotion of responsible trade unionism, the consolidation and rationalization of labor laws, and respect for international labor standards. The labor protection policy 2006 includes a number of issues not addressed in the labor policy, such as minimum wages and related matters, unemployment insurance, and labor market flexibility. The labor inspection policy 2006 provides a new direction for Pakistan's labor inspection systems to enable them to respond to a wide range of labor issues.

In 2007, the population of Pakistan was approximately 165 million. According to the Labor Force Survey (LFS) 2005/06, 50.05 million people are currently active as part of the "labor force." This comprises all persons 10 years of age or above who fulfill the requirements for inclusion among the employed or unemployed according to the LFS. The employed comprise all persons ten years of age or above who have worked at least 1 hour during the reference period and were either "paid employed" or "self employed." The unemployed are defined as all persons ten years of age or above who, during the reference period, were "without work," "currently available for work," or "seeking work." In 2005/06, the number of employed was 46.94 million and the number of unemployed 3.11 million. Of the total labor force, 39.97 million are male and 10.08 million are female. In terms of sectoral distribution, 43.4% are engaged in agriculture and allied industries, 20.7% in manufacturing, and 35.9% in the services sector. Employment by major industry divisions apportions the largest slice (35%) to wholesale and retail trade, followed by manufacturing (21.34%), community, social, and personal services (18%), construction (14%), and transport (11%). The highest absorbing occupational category in 2005/06 was skilled agriculture and fisheries (35.31%), followed by elementary (unskilled) occupations (19.23%), craft and related occupations (15.76%), legislators, senior officials, and managers (11.98 %), and services (5.37%).[2]

[2] Pakistan Labor Force Survey 2005-06, Federal Bureau of Statistics, Islamabad.

III. Model Specifications

Human capital theory is widely used in literature as a base for the earnings function of labor. The notion that education and training increases productive capacity similar to physical capital investment goes back at least to Adam Smith (1776). However, the systematic analysis of considering education and training as a form of human capital investment was initiated in the early 1960s. Pioneers of the human capital revolution include Schultz (1961), Mincer (1962), and Becker (1962). According to human capital theory, workers with additional years of schooling can earn relatively more. Similarly, additional years of schooling are expected to enhance the productivity of workers. Since the 1960s, the neoclassical analysis of labor markets has accorded human capital a significant role, especially with regard to wage determination, and this dominates the economic analysis of education. Mincer and Ofek (1982) quantify the effects of depreciation and restoration of human capital by proving empirically the existence and effects of the depreciation of human capital. A study by Psacharopoulos (1994) has important findings on the rate of return to investment in education. He concludes that

> Primary education continues to be the number one investment priority in developing countries, educating females is marginally more profitable than educating males, the academic secondary school curriculum is a better investment than the technical/vocational track, and the returns to education obey the same rule as investment in conventional capital, i.e., they decline as investment is expanded [*sic*] (Psacharopoulos 1994).

This theoretical background provides a base for using Mincer's earning function augmented by required specifications, and can be implied to estimate the supply-side determinants of wages. This can serve further to explore possible differences in returns with different perspectives and the changing role of individual characteristics in affecting wages during trade liberalization.

III.1. Basic Model

The earnings function in its most basic form was first suggested by Mincer (1974) and has formed the basis for much of the empirical work undertaken in the field of labor economics. The basic model assumes that (i) all individuals are identical, (ii) there are no direct costs of education, (iii) all workers have the same total working life and the same access to capital

markets, (iv) the market is perfect in terms of access to information, and (v) all educational attainment can be captured in a years of schooling variable (S)[3]. The basic model is given as:

$$\ln (W_i) = \beta_0 + \beta_1 S_i + \beta_2 X_i - \beta_3 X_i^2 + u_i \qquad (1)$$

where W is earnings, S is schooling, X is experience, β_1 is the rate of return to schooling/education, β_2 is a coefficient reflecting positive return to experience, β_3 is the negative coefficient of the quadratic experience term X^2 which produces an age earnings profile that is concave from below, and u is a residual term. Estimating the rate of return to an additional year in education is important from the policy viewpoint since it answers the question, is it worthwhile investing in human capital or not. The concave age-earnings profile is usually discerned from empirical data on earnings, which suggests increasing earnings with age with declines setting in subsequently as human capital depreciation effects take hold.[4]

III.2. Augmented Mincerian Earnings Function

The semi-logarithmic form of the Mincerian equation has formed the basis for estimating richer specifications in this study to capture multiple factors, including gender differences in earnings, job location differences in earnings, marital status, differences attributable to different occupations and employment status, and more specifically the inclusion of different mutually exclusive educational qualifications to obtain an annualized rate of return to education. The specification of the model used in the study is given as:

$$\ln (W_i) = \beta_0 + \beta_1 age_i - \beta_2 age_i^2 + \beta_3 gend_i + \beta_4 techtr_i + \beta_5 prim_i + \beta_6 midd_i + \beta_7 matr_i + \beta_8 interm_i + \beta_9 prof_i + \beta_{10} univ_i + \beta_{11} pgrad_i + \beta_{12} urb_i + \beta_{13} casu_i + \beta_{14} prate_i + \beta_{15} marr_i + \beta_{16} wid_i + \beta_{17} prof_i + \beta_{18} tech_i + \beta_{19} clerk_i + \beta_{20} serv_i + \beta_{21} skil_i + \beta_{22} craft_i + \beta_{23} plant_i + \beta_{24} elem_i + u_i \qquad (2)$$

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[3] Although the Mincerian Earning Function assumes a homogenous labor market, this assumption does not hold in context of this study. The available data from two LFS does not permit provincial coverage.

[4] The level of experience at which log earnings are maximized can also be obtained from this equation. This can be done by taking differential of earning function with respect to experience X, setting derivative equal to zero and solving for X. This is given as;

$$\frac{\partial \ln(W_i)}{\partial X_i} = \beta_2 + 2\beta_3 X_i = 0 \qquad \Rightarrow X^* = \beta_2 \div [-2\beta_3]$$

The natural log of hourly wages is used as the dependent variable because hours worked vary over lifecycle and level of education and can also vary across sector. The age and age squared is used as a proxy for experience as data for certain variables required to measure experience directly are not available. Gender is assigned a value of 1 if the individual is male and 0 if female; urban is assigned a value of 1 and rural a value of 0. Other variables include marital status, employment status, educational qualifications, and occupational categories.[5] Another point worth mentioning is that the interpretation of estimated effects by introducing dummy variables in semi-logarithmic specifications of the model is not straightforward and are interpreted after converting into percentage differential in earnings relative to respective base category as $[e^{b}_{vt} -1]$ for various estimates.

The annualized rate of return to different educational qualifications can be computed for different qualifications using conventional formulae. For primary and subsequent education levels, the formulae are given as:

$$\text{Primary: } \frac{\beta_5}{P_{Years}}$$

$$\text{Middle: } \frac{\beta_6 - \beta_5}{M_{Years} - P_{Years}}$$

Where P_{Years} = the total number of years taken to complete a primary qualification; M_{Years} = the total number of years taken to complete middle school. Similarly, the return to matric, intermediate and higher degrees can be computed by taking difference of estimates and diving by difference in number of years to respective qualification. The rates of return are computed using the OLS estimates and the sampling variances for these returns are computed in a straightforward manner using the OLS variance-covariance matrix.

The estimated coefficients of occupational categories are an important part of the wage equation. Other than the simple coefficients, relative wages for each occupational category can also be computed with the following formula;

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[5] The dummy variables are formed in order to measure the qualitative variables and to avoid the 'dummy variable trap', one category in each variable is omitted during estimation. The 'no formal education' is the omitted category among different 'educational qualification', 'regular' employees is the base category in the 'employment status', 'not married' in the 'marital status' variable, and the 'managers' is the base category among different 'occupational groups'.

$$\text{Related share of occupation}_j = \beta_j - \sum_{j=1}^{k} \beta_j \times \overline{occu}_j$$

Where

β_j = is estimated coefficient of j_{th} occupational category

$\overline{occu_j}$ = mean of wages in the j_{th} occupational category

$\sum_{j=1}^{k} \beta_j \times \overline{occu_j}$ = weighted average of all occupational categories

and j = 1. . . k, is for nine occupational categories according to their standard classification.

IV. Econometric Methodology

The econometric methodology used in estimation is defined below.

IV.1. Mean Regression

First, a pooled regression is carried out using the OLS method applied to the dataset from the LFS 1990/91 and LFS 2005/06. The relevant econometric assumptions are as follows: $u_i \sim N(0, \sigma^2)$. In the context of the OLS estimation procedure, the assumption of normality has implications for the testing principles used (i.e., t-tests, F-tests, etc.). The use of the assumption in the context of the Mincerian earnings equation is not without some support. In particular, it is reasonable to assert that labor market earnings follow a log-normal distribution. This distribution has a long right-sided tail to capture the fact that a small number of labor market agents earn exceptionally high wages. It can be shown that, if earnings follow a log-normal distribution, the logarithm of earnings follows a normal distribution, since logging the larger values compresses their size. This provides empirical justification for the use of the semi-logged form in estimation.

IV.2. Quantile Regression

Recent literature shows that "average" regression can provide a misleading impression as to the variation in the magnitude of the ceteris paribus earnings differences across the wage distribution. There is a rapidly expanding body of literature in economics concerning quantile regression that

makes a persuasive case for the value of "going beyond models for the conditional mean" as stated by Koenker and Hallock (2001). The quantile regression approach provides a less data-demanding complementary model that can be informative about the impact of covariates at different points of the conditional wage distribution. In the use of a quantile regression model, the focus moves away from the mean to other selected points on the conditional wage distribution and the estimation procedure is formulated in terms of absolute rather than squared errors. The estimator is known as the least absolute deviations estimator.

Estimating a set of conditional quantile functions potentially allows the delineation of a more detailed portrait of the relationship between the conditional wage distribution and the selected covariates. Hence the quantile regression method offers a mechanism for estimating models for the conditional median function and the full range of other conditional quantile functions (i.e., the 10^{th}, 25^{th}, 75^{th} or 90^{th} percentile) since it is generally desirable to explore quantile regression other than at the median. In contrast to the OLS approach, the quantile regression procedure is less sensitive to outliers and provides a more robust estimator in the face of departures from normality (Koenker 2005, Koenker and Bassett 1978).

Mosteller and Tukey (1977) best explain it as follows:

> What the regression curve does is give a grand summary for the averages of the distributions corresponding to the set of x's. We could go further and compute several different regression curves corresponding to the various percentage points of the distribution and thus get a more complete picture of the set. Ordinarily this is not done, and so regression often gives a rather incomplete picture. Just as the mean gives an incomplete picture of a single distribution, so the regression curve gives a corresponding incomplete picture for a set of distribution.

Selection Bias

There is potential for a selection bias in the estimated earnings equation as the sample of workers might not represent a random sample drawn from the population. In the context of the mean regression model, Heckman (1979) and Lee (1983) provide well-known solutions. The two-step procedure exploits estimates from a multinomial logit model (MNL) to construct the set of selection correction terms (Lee 1983). Admittedly, the estimation of models with selection effects is always a difficult task. A set

of instruments is required to identify the parameters of the earnings equation, which includes the selection effects. These identifying instruments are mostly demographic variables and generally exert a significant impact on the current labor force activity of respondents but not on their labor market earnings. In simple words, the instruments selected should influence employment status but not wage. This identification proved a hurdle in handling selection bias in this study due to the lack of proper instruments in the Labor Force Surveys. The issue is usually addressed by using the generalized framework popularized by Lee (1983) in general studies of wage differentials and decomposition using labor force survey data and traditionally reporting results both with and without correction for the selectivity bias (Gyourko and Tracy 1988). However, only one study (Dutta 2007) appears to address this issue while dealing with trade and wage linkages and controlling for individual characteristics. In our case, there is no variable in the datasets that might be used as an instrumental variable in a multinomial function, which appeared to be insignificant for wage functions.

V. Data Description

The data used in this study is cross-sectional and is drawn from the nationally representative LFS for Pakistan for 2005/06, a period specified as post-trade liberalization, and for 1990/91, the initial year of trade liberalization. Hence, we compare the behavior of different wage determinants across two ends. No data were available on household wages for the period before 1990/91. The working sample used is based on wage employment and comprises a total of 8,006 workers for 1990/91 and 9,894 for 2005/06, once missing values and unusable observations are discarded. Data collection for the LFS is spread over four quarters of the year in order to capture any seasonal variations in activity. The survey covers all urban and rural areas of the four provinces of Pakistan as defined by the 1998 population census. It excludes the Federally Administered Tribal Areas (FATA), military restricted areas, and protected areas of NWFP. These exclusions are not seen as significant since the relevant areas constitute about 3% of the total population of Pakistan.

Table 1 provides the summary statistics and definitions of variables used in our analysis. The ***natural log of real hourly wages*** (lnwph) is used as the dependent variable. Hourly wages are expressed in Pakistan rupees and calculated by dividing weekly earnings by the number of hours worked per week. For estimation purposes, wages are converted into real wages to make comparisons consistent across years. Real wages are obtained by deflating nominal wages to 2000/01 prices using the nationally representative

consumer price index (CPI). The wages reported in LFS are basically the amount of money earned by persons in cash or in kind and bonuses received and are reported net, after deducting social security contributions and pensions and income tax. The average real wages have increased over the period studied. The standard deviation is quite high among all workers.

From a human capital perspective, *age* and its quadratic are used in the model to examine the wage and age relationship. The age of working employees is restricted, starting from 15 years. The average wage for employees in 2005-06 is 35 years. The variable *gender* (gend) is measured by specifying a dummy with value 1 for males, and shows that labor force participation is considerably higher for males than females, i.e., 0.92 for 1990/91 and 0.88 for 2005/06, though female participation has increased over time. Overall, the participation rate rose from 30.4% in 2003/04 to 32.2% in 2005/06—more for women belonging to rural areas than men residing in urban areas. The inclusion of women in the analysis is to examine the gender gap during the period of trade liberalization in wages.

Marital status is divided into three mutually exclusive categories: (i) not married (ntm), (ii) married (marr), and (iii) widowed/divorced (wid). The majority of workers belong to the second category in our sample. *Technical or vocational training* (techtr) is a minor category, i.e., 0.13 for 1990/91 which declined to 0.03 in 2005/06. The settlement type within which the individual resides is captured by a binary control variable for residing in an urban area. The majority of labor is concentrated in urban areas.

A detailed disaggregation of *educational qualifications* is used to facilitate the computation of the private rate of returns to these qualifications. Eight educational categories are used for this purpose. The majority of labor has no formal education (nfed) (0.293), followed by primary (prim) (0.17) and matriculation (matr) (0.164) level of education in 2005/06.

Employment status, another determinant of the earnings function, is divided into three types: (i) regular employees with fixed wages (regul), (ii) casual paid employees (casu), and (iii) paid workers by piece rate or work performed (prate)). In 2005/06, job concentration increased for casual workers (0.057 to 0.224) and decreased for regular workers (0.908 to 0.581) relative to 1990/91.

Occupation is another important factor in the earnings function. Nine one-digit occupational categories are selected, defined according to the Pakistan standard classification of occupations based on the International

Standard Classification of Occupations of 1988 (ISCO_88).[6] Overall, labor was mostly concentrated in the clerical (0.22) and services sectors (0.20) in 1990/91 and in the elementary (0.262) and craft sectors (0.256) in 2005/06. The number of skilled agricultural and fishery workers has remained nominal in both years.

[6] The Revised International Classification of Occupation (ISCO_88), ILO, Geneva, 1990.

Table-1: Summary Statistics

Variable	Definition	Mean (1990/91)	Mean (2005/06)
Log Earnings: lnwph	Natural log of the hourly wage	2.02 (0.670)	3.28 (0.802)
Age	Age of individual in years	33 (11.06)	35 (11.12)
Gender: Gend	=1 if individual is male; = 0, otherwise	0.92	0.88
Technical Training: Techtr	=1 if individual has technical or vocational training; = 0, otherwise	0.135	0.03
Marital Status: Ntm	=1 if individual is not married; = 0, otherwise	0.27	0.25
Marr	=1 if individual is married; = 0, otherwise	0.70	0.73
Wid	=1 if individual is widowed or divorced; = 0, otherwise	0.02	0.021
Education: Nfed	=1 if individual has no formal education; = 0, otherwise	0.29	0.293
Prim	=1 if individual has completed initial five years of education i.e., primary but below middle; = 0, otherwise	0.147	0.17
Midd	=1 if individual has completed initial eight years of education i.e., middle but below matriculation; = 0, otherwise	0.106	0.107
Matr	=1 if individual has completed initial ten years of education i.e., matriculation but below intermediate; = 0, otherwise	0.20	0.164
Interm	=1 if individual has completed two years for college education i.e., intermediate but below post intermediate; = 0, otherwise	0.097	0.092
Prof	=1 if individual has professional degree (doctors, engineers); = 0, otherwise	0.03	0.021
Univ	= 1 if individual has university degree; = 0, otherwise	0.078	0.147

Pgrad	= 1 if individual has post graduation qualification (M-Phil, PhD); = 0, otherwise	0.037	0.003
Employment Status: Regul	=1 if individual is regular paid employee with fixed wages; = 0, otherwise	0.908	0.581
Casu	=1 if individual is casual paid employee; = 0, otherwise	0.057	0.224
Prate	=1 if individual is a paid worker by piece rate service performed; = 0, otherwise	0.034	0.194
Urbanization: Urb	=1 if individual is living in urban area; = 0, otherwise	0.71	0.66
Profession: Manager	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.04	0.037
Professionals	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.15	0.047
Technician	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.05	0.175
Clerk	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.22	0.073
Services	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.20	0.092
Skilled	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.04	0.010
Craft	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.06	0.256
Plant	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.09	0.045
Elementary	=1 if individual is in this one-digit occupation group; = 0, otherwise	0.14	0.262
Sample Size		8,006	9,894

Notes: Average values for continuous measures and sample proportion for discrete measures are reported. Standard deviations are also reported for continuous variables in parentheses.

VI. Empirical Results and Interpretation

The following section interprets the earning function estimates from different perspectives.

Earning Function Estimates and Trade Liberalization

Table 2 provides earnings equation estimates for the LFS 1990/91. The results are reported for mean and quantile regressions. Quantile regression results are reported for the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Similarly, Table 3 provides results for the LFS 2005/06. By and large, the estimates appear to have similar signs for both years with high statistical precision (low standard errors). All models fit well with most of the variables appearing statistically significant at a 1% level of significance and reasonably high values for R^2 and F-stat, keeping in view heterogeneity across workers. The earnings equation explains the relatively high proportion (40%) of total variation in earnings among individuals. Multicolinearity was checked for the models with the help of a variance inflation factor (VIF) and no variable reported a VIF value of more than 10.[7] This shows that multicolinearity is not a problem. Heteroskedasticity was checked and adjusted for in the models by applying the White-heteroskedastic technique. Now we turn to the interpretation of these results.

Human Capital Factors

As typically reported in studies of earnings functions, *age* enters as positively significant while its quadratic term enters as negatively significant in the earnings equation, following age depletion effects. A concave age-earnings profile suggests that wage increases with age at a decreasing rate and that this is due to the human capital depletion effect. The age-earnings profile peaks at 53 years of age in both years. It is worth noting that the average age at which earnings are maximized is similar in both years. No change in wage determination regarding age occurred across the periods; rather the magnitude remained the same for *age* and *age squared*.

The quantile regression findings for *age* and *age squared* confirm the nonlinear age-earnings profiles for both years. The estimates for age at median are broadly in conformity with the mean regression and this could be taken to imply that outliers exert little influence on mean estimates.

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[7] A rule of thumb is provided by David G. Kleinbaum, Lawrence L. Kupper and Keith E. Muller (1988), "*Applied Regression Analysis and other Multivariate Methods"*, 2nd ed., PWS-Kent, Boston, Mass, p. 210.

The variable *technical training* yields a negatively significant finding for the year 2005/06 whereas it is statistically insignificant for 1990/91. The coefficient for 2005/06 shows that technically trained workers earn 9% less than workers with no training. The quantile regression estimates provide a better insight: in the lowest paid jobs located in the 10^{th} and 25^{th} percentiles of the conditional wage distribution, technically trained workers earn significantly less than nontrained workers, while in the highest paid jobs in the 75^{th} and 90^{th} percentiles the difference is statistically insignificant in 2005/06. It implies that technically trained workers getting the lowest paid jobs earn significantly less than nontrained workers. Their training does not provide them highly paid jobs nor does it give them a wage premium compared with nontrained workers. Comparatively, in the highest paid jobs, trained workers are no more disadvantaged than nontrained workers, and both earn similar wages (no statistical difference). In contrast, for 1990/91 at the top-end of wage distribution, the return to trained workers is statistically positively significant and insignificant in low-paid jobs in the 10^{th}, 25^{th}, and 50^{th} quantiles. This postulates that technical training in 1990/91 rewarded workers with higher wages and high-paid jobs due to their training while trained workers in the lowest paid jobs were not getting particularly different wages than nontrained workers and this difference disappeared over time. These findings can be supported by the argument that technical infusion during trade liberalization demands the type of training that workers have not been able to acquire over time. Trade liberalization has not provided them wage premiums, even with their technical knowhow, because their training is not at par with the demands of globalization, thus barring trained workers from the potential benefits of free trade.

Table-2: Earnings Function Estimates based on Pooled Data for Pakistan (1990/91)

Variables	Mean Regression	Quantile Regression				
		10th	25th	50th	75th	90th
Constant	1.4568*	0.58*	1.24*	1.71*	2.01*	2.14*
	(0.076)	(0.129)	(0.088)	(0.072)	(0.074)	(0.115)
Age	0.032*	0.049*	0.038*	0.025*	0.020*	0.021*
	(0.004)	(0.006)	(0.004)	(0.004)	(0.003)	(0.005)
Age^2	-0.0003*	-0.0006*	-0.0004*	-0.0002*	-0.0002*	-0.0002*
	(0.00005)	(0.00008)	(0.00006)	(0.00005)	(0.00004)	(0.00007)
Gend	0.147*	0.227*	0.129*	0.100*	0.100*	0.091*
	(0.025)	(0.040)	(0.027)	(0.022)	(0.023)	(0.032)
Techtr	0.020	-0.027	0.0041	0.010	0.043**	0.058**
	(0.022)	(0.034)	(0.023)	(0.019)	(0.019)	(0.029)
Human Capital: Prim	0.050*	0.114*	0.047**	0.032***	0.047**	0.0583**
	(0.019)	(0.031)	(0.022)	(0.018)	(0.019)	(0.028)
Midd	0.169*	0.238*	0.137*	0.121*	0.136*	0.145*
	(0.020)	(0.036)	(0.025)	(0.021)	(0.021)	(0.032)
Matr	0.300*	0.40*	0.279*	0.233*	0.233*	0.256*
	(0.019)	(0.034)	(0.023)	(0.018)	(0.019)	(0.028)
Interm	0.443*	0.514*	0.413*	0.380*	0.356*	0.454*
	(0.023)	(0.043)	(0.028)	(0.024)	(0.025)	(0.038)
Prof	0.863*	0.853*	0.753*	0.801*	0.862*	0.928*
	(0.036)	(0.073)	(0.048)	(0.038)	(0.038)	(0.058)
Univ	0.643*	0.644*	0.538*	0.568*	0.622*	0.720*
	(0.027)	(0.047)	(0.032)	(0.027)	(0.027)	(0.042)
Pgrad	0.883*	0.715*	0.722*	0.804*	0.905*	1.07*
	(0.037)	(0.062)	(0.042)	(0.035)	(0.036)	(0.054)
Job Location: Urb	0.112*	0.142*	0.084*	0.086*	0.095*	0.113*
	(0.014)	(0.023)	(0.016)	(0.013)	(0.014)	(0.019)
Job Nature: Casu	-0.264*	-0.461*	-0.289*	-0.230*	-0.171*	-0.084**
	(0.031)	(0.044)	(0.030)	(0.025)	(0.025)	(0.038)
Prate	-0.391*	-0.766*	-0.47*	-0.335*	-0.136*	-0.107**
	(0.049)	(0.057)	(0.040)	(0.032)	(0.033)	(0.049)

Marital Status: Marr	0.069*	0.089*	0.083*	0.073*	0.081*	0.058**
	(0.017)	(0.029)	(0.020)	(0.017)	(0.017)	(0.026)
Wid	-0.044	-0.103	-0.109**	-0.054	0.0004	0.007
	(0.049)	(0.077)	(0.052)	(0.043)	(0.044)	(0.065)
Professions: Prof	-0.44*	-0.471*	-0.488*	-0.470*	-0.486*	-0.445*
	(0.034)	(0.062)	(0.041)	(0.034)	(0.035)	(0.053)
Tech	-0.352*	-0.431*	-0.456*	-0.393*	-0.345*	-0.352*
	(0.039)	(0.073)	(0.049)	(0.040)	(0.041)	(0.061)
Clerk	-0.57*	-0.556*	-0.607*	-0.583*	-0.611*	-0.565*
	(0.032)	(0.060)	(0.040)	(0.034)	(0.034)	(0.052)
Serv	-0.749*	-0.866*	-0.842*	-0.767*	-0.771*	-0.691*
	(0.035)	(0.064)	(0.043)	(0.035)	(0.036)	(0.057)
Skill	-0.786*	-1.03*	-0.988*	-0.771*	-0.709*	-0.681*
	(0.048)	(0.080)	(0.054)	(0.041)	(0.046)	(0.070)
Craft	-0.566*	-0.650*	-0.665*	-0.646*	-0.617*	-0.558*
	(0.042)	(0.074)	(0.049)	(0.041)	(0.042)	(0.065)
Plant	-0.511*	-0.562*	-0.583*	-0.550*	-0.578*	-0.541*
	(0.037)	(0.069)	(0.047)	(0.038)	(0.039)	(0.061)
Elem	-0.561*	-0.635*	-0.654*	-0.589*	-0.594*	-0.561*
	(0.036)	(0.067)	(0.045)	(0.037)	(0.038)	(0.058)
R^2/Pseudo R^2	0.43	0.25	0.24	0.26	0.31	0.36
F-statistic	237.57	-	-	-	-	-
N	8,006	8,006	8,006	8,006	8,006	8,006

Notes: 1) The standard errors are given in parentheses.
2) The standard errors are robust to heteroskedasticity.
3) *, **, *** denote statistical significance at the 1%, 5% and 10% level respectively using two-tailed test.
4) The base categories are omitted from the model to avoid dummy variable trap.

Table-3: Earnings Function Estimates based on Pooled Data for Pakistan (2005/06)

Variables	Mean Regression	Quantile Regression				
		10th	25th	50th	75th	90th
Constant	0.914*	-0.601*	0.369*	1.118*	1.75*	2.26*
	(0.085)	(0.153)	(0.093)	(0.069)	(0.079)	(0.106)
Age	0.032*	0.053*	0.036*	0.030*	0.022*	0.010***
	(0.004)	(0.008)	(0.005)	(0.004)	(0.004)	(0.005)
Age^2	-0.0003*	-0.0006*	-0.0003*	-0.0002*	-0.0001*	0.0000
	(0.00005)	(0.0001)	(0.00006)	(0.00005)	(0.00005)	(0.00007)
Gend	0.249*	0.52*	0.378*	0.23*	0.127*	0.031
	(0.02)	(0.037)	(0.022)	(0.017)	(0.020)	(0.027)
Techtr	-0.096**	-0.189*	-0.096**	-0.053	-0.053	-0.063
	(0.039)	(0.069)	(0.042)	(0.032)	(0.037)	(0.050)
Human	0.514*	0.023	0.039***	0.051*	0.030	0.045***
Capital:	(0.018)	(0.035)	(0.021)	(0.02)	(0.018)	(0.025)
Prim						
Midd	0.126*	0.104*	0.125*	0.125*	0.066	0.114*
	(0.022)	(0.041)	(0.025)	(0.019)	(0.049)	(0.029)
Matr	0.218*	0.266*	0.215*	0.196*	0.146*	0.195*
	(0.022)	(0.042)	(0.026)	(0.019)	(0.022)	(0.029)
Interm	0.381*	0.453*	0.41*	0.344*	0.280*	0.300*
	(0.027)	(0.056)	(0.03)	(0.025)	(0.028)	(0.038)
Prof	0.716*	0.812*	0.721*	0.626*	0.549*	0.614*
	(0.055)	(0.102)	(0.062)	(0.045)	(0.051)	(0.068)
Univ	0.594*	0.594*	0.566*	0.522*	0.498*	0.586*
	(0.029)	(0.058)	(0.034)	(0.024)	(0.028)	(0.038)
Pgrad	1.150*	1.108*	1.32*	1.07*	1.144*	1.227*
	(0.158)	(0.189)	(0.128	(0.099)	(0.117)	(0.138)
Job	0.009	0.038	0.040*	0.007	0.0157	0.038**
Location:	(0.013)	(0.025)	(0.015)	(0.011)	(0.0133)	(0.017)
Urb						
Job Nature:	-0.295*	-0.295*	-0.344*	-0.33*	-0.278*	-0.221*
Casu	(0.019)	(0.041)	(0.023)	(0.017)	(0.018)	(0.025)
Prate	-0.372*	-0.378*	-0.427*	-0.442*	-0.382*	-0.269*
	(0.022)	(0.046)	(0.025)	(0.019)	(0.021)	(0.028)

Marital Status: Marr	0.041***	0.078**	0.033	0.011	0.037***	0.060**
	(0.021)	(0.04)	(0.02)	(0.017)	(0.020)	(0.027)
Wid	-0.007	0.022	-0.107**	-0.06	0.0006	0.016
	(0.051)	(0.085)	(0.05)	(0.04)	(0.047)	(0.063)
Professions: Prof	0.035	0.108	0.013	0.04	0.014	-0.053
	(0.053)	(0.081)	(0.051)	(0.037)	(0.043)	(0.058)
Tech	-0.36*	-0.118***	-0.27*	-0.414*	-0.545*	-0.616*
	(0.042)	(0.067)	(0.04)	(0.031)	(0.035)	(0.047)
Clerk	-0.445*	-0.106	-0.33*	-0.523*	-0.644*	-0.707*
	(0.045)	(0.075)	(0.045)	(0.034)	(0.038)	(0.052)
Serv	-0.596*	-0.371*	-0.527*	-0.659*	-0.797*	-0.862*
	(0.046)	(0.079)	(0.046)	(0.035)	(0.039)	(0.053)
Skil	-0.670*	-0.250***	-0.495*	-0.752*	-0.93*	-1.059*
	(0.061)	(0.130)	(0.080)	(0.059)	(0.068)	(0.090)
Craft	-0.529*	-0.331*	-0.485*	-0.590*	-0.686*	-0.719*
	(0.046)	(0.08)	(0.046)	(0.034)	(0.038)	(0.052)
Plant	-0.582*	-0.269*	-0.514*	-0.668*	-0.815*	-0.809*
	(0.051)	(0.091)	(0.054)	(0.039)	(0.045)	(0.060)
Elem	-0.623*	-0.275*	-0.48*	-0.693*	-0.900*	-0.992*
	(0.045)	(0.08)	(0.046)	(0.034)	(0.038)	(0.051)
R^2/Pseudo R^2	0.46	0.22	0.29	0.34	0.36	0.36
F-statistic	335.18	-	-	-	-	-
N	9,894	9,894	9,894	9,894	9,894	9,894

Notes: 1) The standard errors are given in parentheses.
2) The standard errors are robust to heteroskedasticity.
3) *, **, *** denote statistical significance at the 1%, 5% and 10% level respectively using two-tailed test.
4) The base categories are omitted from the model to avoid dummy variable trap.

Table-4: Rates of Return to Educational Qualifications

Education	ROR (2005-06)	ROR (1990-91)	Differential
Primary	0.0103*	0.0102*	0.0001
	(0.0037)	(0.0038)	(0.005)
Middle	0.0248*	0.039*	-0.0142
	(0.0079)	(0.0075)	(0.0109)
Matriculate	0.046*	0.065*	-0.019
	(0.0121)	(0.011)	(0.0161)
Intermediate	0.081*	0.0715*	0.0098
	(0.0118)	(0.010)	(0.0154)
Professional	0.067*	0.088*	-0.021
	(0.0107)	(0.0073)	(0.0129)
University	0.053*	0.0499*	0.0031
	(0.0064)	(0.0064)	(0.0091)
Postgraduate	0.278*	0.1202*	0.1578**
	(0.0785)	(0.0187)	(0.0807)

Notes: 1) The standard errors are given in parentheses.
2) *, **, *** denote statistical significance at the 1%, 5% and 10% Level, respectively using two-tailed test.
3) In computing the rates of return we assumed Primary = 5 years; Middle = 3 years; Matriculation = 2 years; Intermediate = 2 years; Professionals = 5 years; University = 4 years; Post graduation = 2 years.

Table-5: Relative Wages for Occupational Categories

ISCO	Occupation	Relative Wage (2005/06)	Relative Wage (1990/91)
1	Managers	48%	56%
2	Professionals	52%	11%
3	Technicians	12%	20%
4	Clerks	3.6%	-1.4%
5	Services	-11%	-20%
6	Skilled	-19%	-22%
7	Crafts	-5%	-0.4%
8	Plants	-10%	4.6%

The ***human capital theory proposition*** of wage premiums for higher education is also supported by estimates for overall labor. Education levels determine countries' absorptive capacity, i.e., their capacity to adopt new technologies. Education affects the capacity of workers to deal with change in the wake of globalization that expects individuals to adapt constantly to new situations. The coefficients for all educational qualifications are statistically positively significant and suggest a sizeable premium to educated employees successively as compared to employees with no formal education in both years. The wage premium has also increased successively for every higher qualification. A postgraduate degree yields the highest earnings (88% in 1990/91 and 115% in 2005/06) as compared with no formal education in both years, which also depicts increased wage premiums to postgraduates in the period of trade liberalization. Professional degree holders get higher wages than simple Master's degree holders.

A point worth noting is that earnings are larger in magnitude in 1990/91 than in 2005/06 for each qualification in comparison with the base category except postgraduates. The question arises whether the quality of education up to university level in the period of trade liberalization does not meet the demands of globalization and has not increased workers' productivity to accord them better returns and better jobs. Another reason for the lower earnings at each level of education other than postgraduate in 2005/06 could be the nonabsorption of overall labor in job markets in Pakistan. This points to 'under-employment' in the job market. Educated workers who earned less in 2005/06 than 1990/91 may be an indicator of the inability of workers to get jobs and wages according to their potential, thus forcing them to work at a lower wage level. This also points out labor demand constraints in the labor market. Comparatively, the supply of postgraduate employees is considerably less than demand in the labor market and the wage premium for postgraduate degree-holders has increased in the phase of trade liberalization.

However, the computed return to educational qualifications shows no statistically significant differences across time other than postgraduate as reported in Table 4. Table 4 reports the ***rate of return to education*** in both years with their differentials, reported in column (3) and provides evidence of how returns have evolved over the period of trade liberalization. The difference in returns appears statistically significant at the 5% level of significance for postgraduates only and shows a 15% increase in returns to postgraduate degrees in the period of trade liberalization. For all other educational categories this appears insignificant, either negative or positive, and hence suggests no meaningful difference. It is important to point out that the same trend in the rate of return to education for overall labor was

found by Psacharopoulos (2002). In his study, the rate of return to primary level of education was 8.4%, for secondary level, 13.7%, and 31.2% for higher education in 1991. In Pakistan, the overall rate of return to education is computed at 15.4% for the same year.

At each quantile, educated workers earn more than workers with no formal education, which suggests a sizeable wage gap among workers with different qualifications. Postgraduate degree holders earn higher wages in each quantile in 2005/06 than 1990/91 while wages are lower for all other qualifications in 2005/06 than 1990/91. Overall returns to education indicate the significant role of education, but in the period of trade liberalization only a postgraduate degree is capable of providing wage premiums to workers.

Gender Wage Gap and Marital Status

Estimates for the variable *gender* yield a positive and statistically significant value indicating that males earn significantly more than females. The estimate shows that males earned about 15% more than females in 1990/91; the gender pay gap has widened over time and males earned almost 25% more in 2005/06. With regard to the quantile regression estimates, there is little evidence of an increased gender wage-gap moving across the conditional wage distribution in a year. At the lowest paid jobs males are getting significantly more than females but the wage gap contracts when we move along the wage distribution and the difference in wages for the highest paid jobs disappears in 2005/06. The wage gap between low-paid jobs in 2005/06 is more pronounced than in 1990/91. This implies that trade liberalization has influenced the wage gap in favor of males over time but that, in the highest paid jobs, this effect was not as acute.

Hence, the evidence from the labor market of Pakistan suggests that the ceteris paribus gender pay gap declined across the wage distribution in the period of trade liberalization. These findings can suggest that "sticky floors' rather than 'glass ceilings' is a possible description of the female experience in Pakistan where women are concentrated in low paying jobs at the bottom end of the wage distribution, while at the top there is little evidence of a ceiling preventing them from gaining parity with men as put forward by Hyder (2005). But a careful observation of the small number of females working at the top-end of wage distribution in the labor market of Pakistan provides a better explanation for such results. This postulates that women are facing considerable obstacles to move upward and to join the highly paid group and hence, there are very few women in high paid jobs while too many women are in low paid jobs, leading to insignificant results

for wages at the top end. The major hindrances in the way of women moving upward are the gender discrimination on account of cultural restrictions, household responsibilities, and low levels of education and skills.

Regarding ***marital status***, married workers appear to earn more than unmarried workers as the estimate is positively statistically significant. For widowed/divorced workers, the result is insignificant, which could be due to the small number of observations. The result shows that married workers earn 7% and 4% more in 1990/91 and 2005/06, respectively. These results are consistent with the belief that married workers earn more because they are more productive than single workers due to their responsibilities of supporting families but in 2005/06 this difference had declined.[8]

Job Attributes

Job location, another important factor, yields an insignificant coefficient for the year 2005/06, while it is statistically positively significant for 1990/91. Workers belonging to urban areas earned 11% more than workers in rural areas in 1990/91. However, the location-specific wage gap disappears over time and becomes insignificant by 2005/06.

Similarly, the variable ***job nature*** appeared to be negatively statistically significant for casual and piece rate workers in both years as compared with regular pay employees. The estimates postulate that casual workers earned almost 30% less than regular employees in 2005/06 and 26% less than regular employees in 1990/91 and piece rate workers 37% and 39% less than regular employees in 2005/06 and 1990/91, respectively.

Regarding quantile regression results, the estimated coefficients for ***job nature*** show that the wage gap has declined among regular and casual and piece rate workers when we move from the lowest to highest wage earners. At the bottom end, the difference between the wages of casual and piece rate workers from regular employees is acute while at the top end this difference is smaller in magnitude. This could imply that, due to globalization, new multinational firms are providing highly paid jobs to workers and we do not find large differences among types of jobs. The lowest paid jobs that are usually locally based have generated wage gaps among workers. However, when observed over time, the wage gap has widened moving from the lowest to highest paid jobs. This indicates

[8] Not all variables are required to be analyzed from trade liberalization's point of view as these are included in regression for being a part of traditional earnings function.

increased wage inequality among workers during the period of trade liberalization.

Occupational Categories

The mean regression estimates yield negatively statistically significant coefficients for all occupational categories other than professionals in 2005-06, as compared with the base category i.e., managers (legislators, senior officials, and managers) for both years. In 1990/91, the skilled group (market-oriented skilled agricultural and fishery workers) and services group earned about 100% less than managers, followed by clerks and craft workers who earn 77% less wages than managers. Similarly, in 2005/06 the lowest wages went to skilled workers, i.e., 95% less than managers, while elementary workers received 86% less, services 81% less, and plant workers 79% less than managers. In addition, less dispersion is observed in the wages of the eight occupational groups as compared to the managers' group in a given year and the wage gap has contracted for the clerical group, services and skilled workers, widened for elementary workers and more or less remained the same for other groups over the period of trade liberalization.

The relative wage shares to look into the distribution of wages across the occupational groups are obtained by finding the deviation from the weighted average of all occupations and are reported in Table 5. The computed relative wages imply that, on average, skilled, elementary, services, plant and craft workers earn 19%, 14%, 11%, 10% and 5% below the average, respectively, while professionals, managers, technicians and clerks earn 52%, 48%, 12% and 3.6%, above the average in 2005/06. The lowest wage share is that of skilled workers (-19%) in 2005/06 and the highest wage share is that of professionals (52%).

Likewise, the wage share in 1990/91 is 22% and 20% below average for the skilled and services group, respectively, whereas managers, technicians, and professionals workers earn 56%, 20% and 11% above the average. The key point is that the lowest wage share goes to the skilled workers' occupational group in both years. Wage dispersion across occupational groups was more pronounced in 1990/91 among the below average wage groups and not very sharp in 2005/06 in any group, which implies a declining trend in wage gaps across occupations. Another remarkable point is that the relative wage share of professionals has increased considerably from 11% to 52%. The drastic increase in the wage share of professionals shows the enhanced value of this occupation in the new era. The quantile regression estimates yield statistically negatively significant results for all groups other than professionals in 2005/06 and

suggest lower returns to each profession as compared with managers for both years. This difference is more acute at the top-end of the wage distribution in 2005/06 whereas in 1990/91 it is severe for most occupations at the bottom-end. This postulates that in the period of trade liberalization, workers associated with highly paid jobs are earning higher returns than managers. The wage gap has widened not only moving along the wage distribution toward the upper quantile of wage distribution but this gap has also widened at the top-end of wages over the period of trade liberalization. The wages in highly-paid jobs (managers and professionals in both years) are highly responsive to trade liberalization.

Overall, mean regression estimates display the expanding trend in the wage gaps in the period of trade liberalization in the labor market of Pakistan with some exceptions. More specifically, the gender gap has widened over time and the rate of return to the highest educational degree, i.e., postgraduate, has statistically significantly increased in the trade liberalization period—an indication of rising wage inequality among workers with highest educational qualification. The relative wages of different occupational groups have changed by a significant margin in highly paid jobs specifically while professionals' wage share has increased by great margin.

VII. Conclusions and Policy Suggestions

This study was intended to estimate the supply-side determinants of wages in the labor market that are specific to each worker. Subsequently, these factors were compared across two time periods, 2005-06 and 1990-91 from various perspectives: gender gap, human capital theory, job attributes and others to examine the effects of trade liberalization. The rate of return to educational qualifications and relative wage shares to nine occupations were also computed in order to gain a deeper insight. Overall, the results obtained suggest an increasing gender pay gap, some degree of stability in the rate of return to most educational qualifications but increased returns to the highest qualification in the period of trade liberalization, and relative wage shares have changed slightly across occupations. In addition, the pattern of wage premiums vary with human capital factors, gender and occupations along the conditional wage distribution.

In the light of these results, our major findings by no means imply that opening up trade should be avoided but the labor market needs to be adjusted to reap the benefits of trade liberalization. One striking point in pursuance of the effect of insufficient trade reforms on wage structure is that (i) either trade reforms have been implemented in such way that they are not capable of affecting the labor market, or (ii) labor market rigidities

do not allow these effects. Different implications flow from these results. The educational rates of return provide incentives for investing in education as the average wage to all educational categories is almost successively higher than that of workers with no formal education and the rate of return also tends to increase from lower to higher with the degree of education over time. However, education must be in accordance with the new demands of technically-induced trade liberalization. On the one hand, the findings recommend that the Government generate sufficient jobs in accordance with educational qualifications and improve job market conditions while on the other, it urges the workers to attain an education level that is in keeping with competition in the new era.

Although trade liberalization cannot be considered a binding force as far as workers' decisions to acquire education are concerned, it can motivate them to adapt to prevailing market conditions. From the occupational choices view point, although this does not demand that workers switch from their existing profession to the highest paid job available, it is important that they keep up to mark in the new era of trade liberalization, to be able to compete with the new skill-demanding and external-oriented environment. The findings suggested by the study provides some potentially fruitful areas for future research. Control over the quality of education is also worth investigating further.

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The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 39-68

The Impact of Socioeconomic and Demographic Variables on Poverty: A Village Study

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Abstract

Poverty is a complex phenomenon based on a network of interlocking economic, social, political, and demographic factors. An understanding of the extent, nature, and determinants of rural poverty is a precondition for effective public policy to reduce poverty in rural Pakistan. The present study attempts to analyze the impact of socioeconomic and demographic characteristics of households on poverty, using primary data collected in the village of Betti Nala in Tehsil Jatoi, district Muzaffargarh in southern Punjab. We have used two distinct approaches: (i) a poverty profile, and (ii) an econometric approach in our empirical analysis. The results show that household size, dependency on household, participation, landholdings, and number of livestock have a significant impact on poverty incidence. Our final conclusion is that efforts should be made to improve socioeconomic factors in general and demographic factors in particular to alleviate rural poverty in remote areas of Pakistan, while land should be allotted to landless households.

JEL Classification: A13, C10, J19.

Keywords: Poverty, households, Punjab, Pakistan.

I. Introduction

Most societies have at some time in their development process seen a large number of people living in conditions of poverty, unable to afford the minimum essentials for a decent existence. Poverty, in this sense, has long been a historical fact and continues to be an unfortunate feature of life today. Nevertheless, poverty is not a new topic in development economics. Its alleviation has mostly been associated with high economic growth rates.

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Most poor people from less developed countries (LDCs) reside in rural areas and make their living from agriculture. The role of the agrarian structure and institutional settings in general and the rural poor in terms of socioeconomic and demographic factors in particular are of central importance in economic development. Traditionally, however, the agriculture sector and rural economy have been characterized, in most LDCs, by the predominance of a small landowning class, tenants, sharecroppers, and landless laborers who are at the core of the poverty problem. Moreover, rural areas are characterized by relatively low population densities, with maximum population thresholds in settlements.

The major emphasis of Pakistan's model of economic development has been on maximizing the growth of output, leaving too little to take care of mass poverty, socioeconomic disparities, and unfavorable demographic variables. The evidence suggests that Pakistan's economy has shown steady improvement in terms of major macroeconomic indicators. However, in spite of high rates of economic growth, Pakistan's poor, particularly its rural poor, have benefited very little.

A large number of studies on poverty in Pakistan and on rural poverty in particular are available. Most of these studies use data from the Household Income and Expenditure Surveys (HIES) and estimated measures of poverty. Almost all studies agree that rural poverty fluctuated around 40% during the 1960s, then declined in the 1970s and 1980s. The incidence of rural poverty increased in the 1990s, after which it showed a declining trend[1] [Naseem (1973), Irfan and Amjad (1984), Malik (1988), Amjad and Kemal (1997), Ali and Tahir (1999), Jafri (1999), Arif *et al.* (2000), Arif (2000) and Qureshi and Arif (2001)].

Patterns of poverty differ by province, and between rural and urban areas. The data consistently show that poverty is considerably higher in rural areas as compared with urban areas. Punjab accounts for almost 56% of the country's population. About 36% of its rural population is poor and ranks second-highest among the provinces. According to the estimates of the Federal Bureau of Statistics (FBS), 2002, about 40% of the rural population in lower Punjab is poor, the highest incidence after rural NWFP. The International Fund for Agricultural Development (IFAD) (2001), also confirms that poverty is most severe and chronic in the rural areas of southern Punjab, NWFP, and Balochistan. Nevertheless, southern Punjab has received little attention, not only at the level of policy issues but also

[1] See Government of Pakistan, Pakistan Economic Survey, 2005-2006.

empirical inquiry. The severity of the problem is the reason we have chosen to study a village in southern Punjab.

An understanding of the extent, nature, and determinants of rural poverty is a precondition for effective public action to reduce deprivation in the rural areas. The major objective of the present study is to analyze the impact of households' socioeconomic and demographic characteristics on poverty. The profile and correlates of rural poverty are also estimated in a bivariate analysis. The study is divided into five sections as follows: The conceptual framework of poverty and household's characteristics is given in Section II. Section III discusses the issues of data and methodology used in the present study. The results of a detailed profile of the correlates of rural poverty and econometric analysis are reported in Section IV. Section V presents conclusions and policy implications.

II. Poverty and Household Characteristics: A Conceptual Framework

a. Concept of Poverty

The persistence of poverty is linked to its multidimensionality: It is dynamic, complex, institutionally embedded, and a gender- and location-specific phenomenon. The pattern and shape of poverty vary by social group, season, location, and country. There is much ambiguity in the way poverty is discussed by social scientists and analytically quantified by economists. Poverty means being deprived materially, socially, and emotionally. It steals the opportunity to have a life unmarked by sickness, a decent education, a secure home, and a long retirement [Oppenheim and Harker (1996), pp. 4-5].

Almost two and half decades ago, Amartya Sen (1981) addressed this issue in the context of persistent starvation in the midst of plentiful food stocks, noting that different social groups employ different means to gain access and control over food. The simple existence of sufficient food, he asserts, does not necessarily ensure access to that food. The means of securing access, which nearly always involves institutional interaction, are critical. Institutions limit or enhance poor people's rights to freedom, choice, and action [Sen (1984, 1999)].

The World Bank (1990) defines poverty as 'the inability to attain a minimum standard of living'. Later, the World Bank (2000) defines poverty as lack of command over commodities, or as a severe constriction of the choice set over commodities, leading to pronounced deprivation in well being or welfare. This definition is much broader and extends beyond food

and nonfood items to include key assets and social determinants, which are essential for human development.

Lipton and Ravallion (1995) state that, "poverty exists when one or more persons fall short of a level of economic welfare deemed to constitute a reasonable minimum, either in some absolute sense or by the standards of a specific society".

The concept of poverty is not so easy to describe, however, it can be defined in the following general terms: (i) lack of 'means' in relation to 'needs,' i.e., absolute poverty, and (ii) lack of 'means' in relation to the 'means' of others, i.e., inequality or relative poverty. Poverty theorists advocated that the concept of absolute poverty is more relevant to the problems of developing economies than relative poverty. Thus, it is more appropriate to estimate and analyze absolute poverty in a developing country such as Pakistan where the average level of resources is limited.

b. Concept of Poverty Lines

A poverty line is that level of income or expenditure required by an individual to purchase or satisfy a minimum basket of consumption goods and services for him or her to be considered not in poverty. A poverty line is country-specific and this level of income or expenditure varies from one country to another. Irrespective of countries, households or individuals with a per capita income below this line are considered poor, and households with a per capita income above this line are considered nonpoor. Synonymously, a poverty line is an income level, which separates the poor from the nonpoor. Budget standards or the minimum needs approach was the earliest in setting the poverty line and has been used by Booth (1889) and Rowntree (1901). This approach involves the determination of a minimum quantity of various minimum needs or their money equivalent.

Poverty lines are therefore cutoff points separating the poor from the nonpoor. There are two main ways of setting poverty lines: relative and absolute. Most developing countries use an absolute rather than relative poverty line. In an absolute poverty line, the poverty threshold is established as the income level at which households are able to purchase essential food and nonfood items, including social services. This poverty line is fixed in terms of a living standards indicator and over the entire domain of the poverty comparison.

Ravallion (1993, p. 30) defines an absolute poverty line as "one which is fixed in terms of living standards, and fixed over the entire domain

of the poverty comparison", while a "relative poverty line, by contrast, varies over that domain, and is higher than the average standard of living". Different methods have been used in the literature to define absolute poverty lines [see Sen (1979), Deaton (1997), Ravallion and Bidani (1994), Ravallion (1994) and Wodon (1997)].

In this study, we have not calculated an independent poverty line. We have used the poverty line adopted by Malik (1992, 1996) and adjusted it using the CPI of annual changes in prices (*Pakistan Economic Survey*, 2005-2006). The resultant rural poverty line is Rs895.78.

c. Measurement of Poverty

Once the conceptual problems in identifying either a nutritional norm or bundle of basic minimum needs are resolved and a poverty line has been developed or inflated, the next issue is the determination of an appropriate poverty index. Since the work of Sen (1976), taking into account inequality among the poor and not solely the incidence or average intensity of poverty has become common scientific practice. Much of the literature on the development of poverty indices has focused on whether indices are decomposable across population subgroups. This has led to the identification of a subgroup of poverty indices known as the class of decomposable poverty indices'. These indices have the property of being expressible as a weighted sum (more generally, as a separable function) of the same poverty indices assessed across population subgroups. Most commonly they include the Foster, Greer, and Thorbecke (FGT) (1984) poverty indices, Clark, et al (1981) index, Chakravarty (1983) classes of indices and the Watts (1968) index.

The FGT class of poverty indices has become, in the last two and half decades, the most popular class of poverty indices used in theoretical and empirical studies of poverty. The perceived and mentioned advantages of the FGT class of indices in the literature are: its ethical flexibility (captured by the parameter α), its decomposability across subgroups, and its simplicity of computation and understanding among others [Duclos *et al.* (2002)]. In other words, the FGT class of poverty measures can be disaggregated for population subgroups and the contribution of each subgroup to national poverty can be calculated. The measures of poverty depth and poverty severity provide complementary information on the incidence of poverty.

$$P_{\alpha}(Y_I, Z) = \left(\frac{1}{N}\right) \sum_{i=1}^{q} \left[\frac{Z - Y_I}{Z}\right]^{\alpha}$$

Where z is the poverty line and y_i is the per capita income of the i_{th} poor.

For each $\alpha \geq 0$, if $\alpha = 0$, then p_0 is simply the headcount ratio (also called incidence of poverty), while with $\alpha = 1$, p_1 is a re-normalization of the income-gap measure (also called poverty gap). Finally the sensitive measure p_2 is obtained by setting $\alpha = 2$ (called severity of poverty).

d. Understanding the Determinants of Rural Poverty

The determinants of poverty can be macroeconomic or microeconomic. Our study is concerned with microeconomic variables and characteristics.

Economic Characteristics of Households

Economic characteristics include employment, income, consumption spending and household property and assets.

i. Household Employment

There are several indicators that determine household employment. Within this array of indicators, economists focus on the rate of participation in the labor force, the real rate of unemployment, and job changes. The participation rate is the first of the two employment variables used in the analysis. According to Lipton (1983), the higher the illness, disability, income per capita, intensity in customs and religious beliefs, status, the general welfare level and asset holdings, the lower the participation rate in LDCs. In comparing the nonpoor and poor, the positive incentive given by poverty to participation outweighs the negative effect on it; hence, the poor participate more than the nonpoor. In the present study, the participation rate is defined as the ratio of the number of workers to the number of adults in a household. In accordance with the argument given above, the participation rate is expected to be negatively correlated to poverty.

ii. Household Incomes

Income represents a very important area of consideration when characterizing the poor. The level of income is important not only for the households, but its distribution among household members and various socioeconomic groups. Income is difficult to define as it includes several components of which only some are monetary (for example, farm households consume most of their production onsite). Additionally, individuals tend to

make false declarations about their income level, which is generally underestimated. It is possible in part to correct these declarations but only at the cost of carrying out a large-scale data-gathering operation on economic activities, the cost of production, factor inputs, and the prices of products. Given these limitations and the fact that savings are low, even zero, there is often a tendency to use a household's total spending as an approximation of its disposable income. Here, we calculate per capita expenditure per month as a proxy for household income.

iii. Household Property and Assets

The property of a household includes its tangible goods (land, cultivated areas, livestock population, agricultural equipment, machinery, buildings, household appliances, and other durable goods) and its financial assets (liquid assets and other financial assets). These indicators are of interest as they represent the household's inventory of wealth and therefore affect its income flow. Furthermore, certain households, especially in the rural areas of Pakistan, might be poor in terms of income but wealthy when their property is taken into consideration. This class of poverty is called secondary poverty by Rowntree (1901), as it applies to those who appear to have resources but have not been able to utilize them to raise themselves above the subsistence level. However, we will discuss household property and assets under the following heads.

- **Landholdings**

The ownership of agricultural land is considered the main factor that can extricate a household/individual from poverty. The variable or characteristic used in this study is the extent of landholdings per household in acres. This incorporates owner-cum-sharecroppers as well as sharecroppers. On the basis of the role it plays in a rural economy, we hypothesize a positive relation to the per capita income variable. Some technological and agricultural input variables (use of tractor, HYVs, fertilizer and pesticides, and irrigation water, etc.) are also associated with landholdings and have also a positive relation to per capita income.

- **Livestock Population**

The livestock sector is an important sector of the rural economy in Pakistan. The contribution of the livestock sector toward family income is quite substantial. In the present study, this form of property or asset is normally included and measured in monetary units. It also has a positive relation with per capita income in our analysis.

- **Physical Assets**

Physical assets contribute significantly to per capita income. In the present study, physical assets occur in the form of agricultural equipment and machinery, i.e., tractors and accessories, etc., and household appliances such as electronic goods. These are measured in terms of the rupee value of total physical assets.

Social Characteristics of Households

Aside from economic indicators, we also have recourse to social indicators to characterize poverty and household living standards. The social indicators generally selected are health, education, and shelter.

i. Health within the Household

Four types of indicators are normally used to characterize health in analyzing a household's living standards. These indicators include (i) nutritional status (for example, anthropometric indicators such as weight for age, height for age, and weight for height); (ii) disease status (for example, infant and juvenile mortality and morbidity rates as related to certain diseases such as malaria, respiratory infections, diarrhea and sometimes poliomyelitis); (iii) the availability of healthcare services (primary healthcare centers, maternity facilities, hospitals and pharmacies, basic healthcare workers, nurses, midwives, doctors and traditional healers; and (iv) medical services such as vaccinations, access to medicines and medical information, and the use of these services by poor and nonpoor households. It is generally believed that drinking water and sanitation also influence health and nutritional status. Research shows that the poor are extremely disadvantaged in their access to safe sources of water supply and sanitation. Another indicator of housing standards is access to electricity.

ii. Education

According to human capital models, education is an important dimension of the nonhomogeneity of labor. High educational attainment may imply a greater set of employment opportunities and specifically in the rural context, a better awareness of the full potential of new agricultural technologies and associated agricultural practices. Four types of indicators are normally used to characterize education in an analysis of household living standards. These include the number of household members, level of education (literacy rate, with poor households having lower literacy), availability of educational services (primary and secondary schools), the use

of these services by members of poor and nonpoor households (children's enrollment in school, dropout rate of children by age and gender and reasons for dropping out, percentage of children who are older than the normal age for their level of education and average spending on education per child registered) and educational codes. In the present study, educational attainment data is translated into a point system according to the following procedure:

No education for a household member ---------- 0 points

Education completed up to secondary level ---------- 5 points

Education completed up to college or university ---- 10 points

The educational index is constructed by dividing the total number of educational points by household size. This variable is considered a major cause of poverty and points are given to those household members who have completed their education up to secondary level or higher; these members are observed as being older than 14 years and are assumed to be adults[2]. In view of its potential role, we hypothesize a positive relationship with per capita income, and a negative one with poverty incidence.

iii. Shelter

Shelter refers to the overall framework of the personal life of the household. It is evaluated by three components: housing, services, and the environment. Housing indicators include the type of building (size and type of materials, i.e., mud and straw, and baked and unbaked bricks); the means through which one has access to housing; and household equipment. Service indicators focus on the availability and use of drinking water, communication services, electricity, and other energy sources (wood, kerosene, dung cakes, etc.). Finally, environmental indicators concern the level of sanitation (mentioned earlier), the degree of isolation (availability of roads and paths which are usable at all times, length of time taken and availability of transportation to get to work) and degree of personal safety. Type and quality of housing are the result of poverty but also contribute to being poor in terms of unhygienic and unhealthy conditions. It is also established that poor households live in more precarious, poorer sanitary environments, which contribute to the poorer health and lowered productivity of household members and aggravates poverty at existing levels. The variable of housing conditions is taken into account to capture this important issue. On the

[2] For more details, see Malik (1996).

contrary, better housing environment leads to good health and becomes the cause of increasing household income levels and reducing poverty.

Demographic Characteristics of Households

Aside from economic and social indicators, we make use of significant demographic indicators to characterize poverty and household living standards. The demographic characteristics of the household can be broadly classified into three categories, as follows:

i. Household Size and Structure

This indicator is an important one as it shows a possible correlation between the level of poverty and household composition. Household composition, in terms of the size of the household and characteristics of its members (such as age), is often quite different for poor and nonpoor households. The Pakistan Integrated Household Survey of 1998/99 shows that the poor tend to live in larger households with an average family size of 8.4 persons in the poorest quintile compared with 6.2 in the nonpoor quintile. Similar patterns are found in most developing and low-income countries (Malik 1992). Generally it is recognized that more healthy, educated, and adult members in a household contribute to their income levels and reduce poverty; if household members are not adult and educated, they can become the cause of poverty. It is hypothesized that the larger the household size, the higher the level of poverty incidence, and vice versa.

ii. Dependency Ratio

For a given household size, a larger number of children and elderly members would imply a smaller number of earners in the household. In the present analysis, the dependency ratio is calculated as the ratio of the number of members below 15 and over 64 to other household members. Furthermore, child and older member dependency ratios are also calculated using the same formula. This ratio allows us to measure the burden on members of the labor force within the household. One might expect that a high dependency ratio would be correlated positively with the level of rural household poverty.

iii. Female-Male Ratio

The female-male ratio or sex ratio is important in a household in determining the attitude toward work. Although not to be assumed a generalization, female household members in rural Pakistan are often

constrained by cultural norms from working outside their household. This suggests that a high female-male ratio might be related to household poverty.

iv. Age and Gender of Household Head

The age and gender of the household head are also important in determining the attitude toward employment. It is widely believed that the age and gender of the household head significantly influences rural poverty. The age of the household head has a similar role to sex composition, as discussed above.

III. Data and Methodology

In this study, we make use of primary data collected through a household survey in the villages of Chah Qaisar and Kande Wala in Betti Nala, tehsil Jatoi, district Muzaffargarh. The format of the household questionnaire, covering broad aspects of each household's socioeconomic, demographic, and village-specific characteristics, is such that the information could easily be transformed on an individual basis. The modes of household survey data collection are as follows:

(i) Direct questioning of household head and other members;

(ii) Extracting data from participant observation; and

(iii) Interviewing of selected informants.

The household survey was conducted in May and June 2006. The village was characterized by a scattered population. Muzaffargarh district forms one of the southern parts of the province of Punjab and is situated between the Chanab and Sindh rivers. The river Chanab separates the district of Muzaffargarh from the district of Multan. District Muzaffargarh comprises four tehsils, namely, Muzaffargarh, Kot Addu, Jatoi, and Ali Pur. The population of Muzaffargarh district is around 2.8 million with a 52% male and 48% female population. About 74% of the total population resides in rural areas. Overall, the literacy rate is 29%; the male literacy rate is 40% while the female literacy rate is only 14%[3].

We use two distinct approaches, namely bivariate and multivariate analyses. A bivariate analysis of household characteristics can be performed to analyze the correlates of the rural poverty profile. Moreover, the rural

[3] Figures are taken from different documents of the District Government.

poverty profile focuses on presenting the poverty characteristics of various rural household groups. According to Gillespie (1990)

> The effectiveness of poverty studies could be improved by presenting poverty profiles based on information, which is relevant to policy objectives [Gillespie (1990), p. 3].

Poverty measures are the most common and popular approach to presenting a poverty profile to assess how various household groups contribute to overall rural poverty. We employ FGT indices as discussed earlier to calculate a detailed rural poverty profile. The most commonly used poverty measures of FGT indices are the incidence of poverty, depth of poverty, and poverty severity. Hence, a detailed rural poverty profile can be constructed using FGT indices in terms of the socioeconomic and demographic characteristics of households.

In our econometric analysis, we will carry out a multivariate income regression and alternatively a logit model on the potential determinants of rural poverty in terms of a household's socioeconomic and demographic characteristics. These models will be estimated using household data at the village level. The methodology of multivariate income regression models is used extensively by many researchers[4]. In income regressions, the logarithm of income (possibly divided by the poverty line) is typically used as the dependent variable (indicator of well-being). The explanatory variables span a large array of possible poverty determinants along the lines of those discussed in the last section.

The income regression equation can be written in the following form:

$$\text{Ln } w_i = \beta_o + \sum_{j=1} \beta_k X_{ki} + U_i \qquad (1)$$

Where

$\text{Ln } w_i$ = Natural log of per capita expenditures divided by the poverty line[5]

X_{ki} = A set of household characteristics

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[4] See for example, Glewwe (1990), Grosh and Munoz (1996), Kozel (2000), Ravallion (1996), Ravallion and Huppi (1991), and Wodon (2000, 2001).

[5] The log of per capita expenditures is divided by poverty line to normalize the explained variable.

β_k = Parameters

U_i = A random disturbance term

In employing an income regression model, the next step is to construct variables for the model. Here we present the list of selected variables relating to the income regression model of the determinants of rural poverty model in Table-1.

Table-1: List of Variables for the Determinants of Rural Poverty Model (Income Regression Model)

Variables	Variables' Description
Dependent Variable	
ln w_i	Natural log of per capita income expenditures divided by the poverty line
Explanatory Variables	
HSIZE	Size of the household
EDUC	Educational codes (household education level)
PARR	Participation rate
FMRM	Female-male ratio (member)
FMRW	Female-male ratio (worker)
DEPR	Dependency ratio
CDEPR	Child dependency ratio
ODEPR	Old dependency ratio
AGEH	Age of the household head (years)
$AGEH^2$	Age of the household head squared
PPRM	Persons per room in a household
PLSTO	Population of livestock per household
VPAST	The value of physical assets per household in rupees ('000)
LHOL	Landholding per household (area in acres)

It has also become standard practice to analyze the determinants of poverty alternatively through categorical regressions such as the logit and the probit, which are nonlinear probability models. There are some appropriate uses of these models in poverty assessments. First, for targeting analysis, these regressions can be used to assess the predictive power of various variables used for means testing. Second, when panel data are available, these regressions can also be used to analyze the determinants of transient versus chronic poverty. However, the present study is concerned only with the logit model. According to the basic principles of discrete choice models, econometric modeling consists of confronting two alternative and mutually exclusive situations, being considered poor or not. In a logit model, the endogenous variable is a dichotomous or dummy variable, with (1) representing the household as poor and (0) if the household is not poor.

The exogenous variables are taken as the socioeconomic and demographic characteristics of households. The present study follows more or less the same methodology as used by Malik (1996) and Arif *et al.* (2000) but with different data. The list of the variables for logistic estimates of rural poverty determinants is given in Table-2.

Table-2: List of Variables for the Logistic Estimates of Socio-Economic and Demographic Factors Affecting Rural Poverty

Variable	Variables' Description
Dependent Variable	
POV	= 1 If the household is extremely poor = 0 Non-poor or otherwise
Explanatory Variables	
HSIZE	Size of the household
DEPR	Dependency ratio
FMRM	Female-male ratio (member)
HHFM	= 1, If household head is female, = 0 if male
HHLT	= 1 If the household head is literate, = 0 if illiterate
HHFR	= 1 if household head is farmer, = 0 otherwise
HHFL	= 1 If household head is agricultural laborer, = 0 otherwise
HHLB	= 1 If household head is non-farm worker/laborer, = 0 otherwise
AGEH	Age of the household head (years)[6]
HHRS	= 1 If the household resides in a Kacha house, = 0 if Pakka house
EDUC	Education codes (household education level)
PARR	Participation rate
HVHC	=1, If household member visits health center, = 0 otherwise
LHOL	= 1, If household has land holding, and = 0 If landless
PLSTO	Population of livestock per household
PASTH	= 1, If household has physical assets, and = 0 otherwise

[6] Age squared variable is not included in logit model because most of the variables are binary and secondly does not have significant effect on poverty reduction when the dependent variable is binary.

IV. Results and Discussions

The household survey data indicates that households in the surveyed villages are mostly Saraiki-speaking with a small minority being Punjabi-speaking. Infrastructure facilities are very poor: there is no basic health center, no metal road, sanitary conditions are very poor, and educational facilities are also not up to the mark. The village agricultural land is plain and mostly cultivable. The land tenure system consists of both owner-cropping as well as share/rent-cropping. The main crops of the area are wheat, cotton, sugarcane, and maize. There are also some mangoes and pomegranate farms.

a. Decomposition of Rural Poverty by Household Characteristics

A Bivariate Analysis

Before discussing the decomposition of rural poverty by household characteristics, it is necessary to present the estimates of the rural poor using the FGT indices based on our household survey data. The estimates of rural poverty measures are given in Table-3.

Table-3: Rural Poverty Estimates of Households of a Village

Poverty Measures	Poverty Estimates
Poverty Incidence (%)	48.00
Poverty Depth	0.247
Severity of Poverty	0.143

Source: Calculated from the Household Survey Data, 2006.

According to the results of the poverty measures, 48% of households are poor. The poverty depth is about 24.7 which means that 24.7% of the poverty line is required to escape rural poverty. The severity of poverty is estimated at 14.3%, implying that there is 14.3% inequality among the poor. Put differently, a higher weight is placed on those households who are further away from the poverty line. This indicates that how much of a gap is among the poor and what volume of resources is needed to bring these households closer to the poverty line or above it. The results for the incidence of poverty are in line with those of other studies[7] on southern Punjab.

[7] For example, see FBS (2002), Malik (1996) and Chaudhry (2003).

Next, we look at the profile of rural poverty by household characteristics such as size of landholding, household size, educational attainment, participation rate, dependency ratio, female-male ratio (members), female-male ratio (workers), and age of household head. The results are reported in Table-4 to Table-11.

Table-4 shows that the incidence of poverty is high among landless households: 58.3% of the poor are landless. About 27.1% of the poor are landowning households with 1 to 3.5 acres of land. As far as the acuteness of poverty is concerned, the poverty depth is 18.9%. In other words, 18.9% of the poverty line is needed to escape from poverty for landless households. The severity of poverty is also very high (10.6%) among landless households as compared with landowning households. Households with less than 3.5 acres are disproportionately poor. It is evident from the results that poverty incidence falls as the size of landholding increases.

The estimates in Table-5 suggest that all poverty measures gradually increase with the increase in household size except those comprising 6 members. We can conclude that the household size found most prone to rural poverty is one with 7-8 and above members/households. There was no household consisting of 1 member in the total sample. Therefore, a household of 2 members (4% of the total population) escapes not only from the incidence of poverty but also from poverty depth and severity. A household of 8 or more members (26% of the total household population) has the highest incidence, depth and severity of poverty. Rural poverty is more severe and sensitive among large households.

According to human capital models, education is an important dimension of nonhomogeneity of labor. To look into this more explicitly we decomposed the FGT indices of poverty in terms of levels of educational attainment. The results are given in Table-6. They suggest that the incidence of poverty, as well as its depth and severity are much higher among households with no educational attainment. The last two subgroups have the lowest level of incidence, depth, and severity of poverty. This implies that households with higher levels of educational attainment are correlated with a reduction in rural poverty.

The labor force participation rate is the prime variable of employment used in our analysis. The estimates reported in Table-7 show that, as the participation rate of households increases, the incidence; depth and severity of poverty fall. The third poor subgroup has the lowest severity of poverty with a high participation rate.

We have also decomposed poverty in terms of the dependency ratio. The results are given in Table-8. We start with the dependency ratio, which has a significant impact on a household's well being. The results show that as the dependency ratio increases from the first to second category, the poverty incidence, depth and severity increase. Since these two categories make up two-thirds of the households, his tendency supports our hypothesis that poverty will be more severe among those households with a higher dependency ratio.

The gender issue also plays an important role in poverty analysis. To address this issue, we have developed female-male ratios for individuals and workers. The decomposition of poverty (FGT indices) in terms of these two different characteristics has been undertaken in Tables-9 and 10. Poverty is more severe in households that have a high female-male ratio of workers (see Table-10). This is mainly because females are engaged in the agricultural sector, where there is a large proportion of disguised unemployment.

The role of the age of the household head in poverty analysis also gives some interesting results and supports the current phenomenon of youth unemployment where considerable incidence, depth and severity of poverty are observed in Table-11. About 23% of households are in the age group 20-35 and poor. As this comes to 39% of the total household population, nearly half of the poor are in this age group. They need 12.7 percent of the poverty line to escape poverty. The incidence, depth and severity of poverty decrease as the age group of the household head increases, along with work experience and income.

Table-4: Decomposition of Poverty by Size of Landholdings

Size of Land (acres)	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
Landless	58.3	51.00	28.00	0.189	0.106
1 – 3.5	27.1	20.00	13.00	0.053	0.031
3.6 – 7.0	14.6	17.00	07.00	0.005	0.006
7.1 and above	-	12.00	-	-	-

Source: Calculated from the Household Survey Data, 2006.

Table-5: Decomposition of Poverty by Household Size by Members

Household Size	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
1	-	00.00	-	-	-
2	-	04.00	-	-	-
3	6.3	07.00	3.00	0.012	0.008
4	12.5	13.00	6.00	0.028	0.015
5	14.6	16.00	7.00	0.052	0.027
6	18.8	14.00	6.00	0.031	0.019
7	35.4	20.00	9.00	0.049	0.024
8 and above		26.00	17.00	0.075	0.050

Source: Calculated from the Household Survey Data, 2006.

Table-6: Decomposition of Poverty by Educational Attainment

Education Codes	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
0.00 – 0.00	66.7	37.00	32.00	0.161	0.092
0.01 – 1.00	20.1	16.00	10.00	0.064	0.028
1.01– 3.00	8.3	12.00	04.00	0.013	0.019
3.01 and above	4.2	35.00	02.00	0.009	0.004

Source: Calculated from the Household Survey Data, 2006.

Table-7: Decomposition of Poverty by Labor Force Participation Rates

Participation Rates	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
0.00 – 0.33	81.3	42.00	39.00	0.189	0.121
0.34 – 0.67	14.6	37.00	07.00	0.045	0.013
1.68 – 1.00	4.2	21.00	02.00	0.013	0.009

Source: Calculated from the Household Survey Data, 2006.

Table-8: Decomposition of Poverty by Dependency Ratio

Dependency Ratio	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
0.00 – 0.33	25	30.00	12.00	0.063	0.036
0.34– 0.67	31.2	35.00	15.00	0.095	0.043
0.68– 1.00	16.7	13.00	08.00	0.041	0.026
1.01 and above	27.1	22.00	13.00	0.048	0.038

Source: Calculated from the Household Survey Data, 2006.

Table-9: Decomposition of Poverty by Female-Male Ratio (Members)

Female-Male Ratio (Members)	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
0.00 – 0.50	37.5	27.00	18.00	0.086	0.051
0.51– 1.00	43.8	38.00	21.00	0.113	0.062
1.01 and above	18.8	35.00	09.00	0.048	0.030

Source: Calculated from the Household Survey Data, 2006.

Table-10: Decomposition of Poverty by Female-Male Ratio (Workers)

Female-Male Ratio (Worker)	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
0.00 – 0.33	39.6	38.00	19.00	0.153	0.084
0.34 – 0.63	31.3	33.00	15.00	0.072	0.051
0.64 –1.00	8.3	29.00	04.00	0.022	0.008

Source: Calculated from the Household Survey Data, 2006.

Table-11: Decomposition of Poverty by Age of Household Head

Age of Household Heads (Years)	As %age of Poor	Households (percent)	Poverty Incidence (percent)	Poverty Depth	Severity of Poverty
20 – 35	47.9	39.00	23.00	0.127	0.069
36 – 50	25	27.00	12.00	0.059	0.036
51–65	18.8	19.00	09.00	0.041	0.030
66 and above	8.3	15.00	04.00	0.020	0.008

Source: Calculated from the Household Survey Data, 2006.

b. Results of Multivariate Regression Models

A village study data of 100 households is used to estimate the log-linear multivariate model. In order to check the impact of socioeconomic and demographic variables on rural poverty, a log linear multivariate model is estimated.

The empirical results show the explanatory power of the regression equations, as measured by R^2, to be significantly high (R^2 = 79.50 and 80.30, respectively in two equations). In other words, an average of 79% of the variation in the dependent variable (natural log of per capita income divided by poverty line) is due to the explanatory variables and the remaining 21% is due to other unmentioned variables. The joint or overall test of significance, F-test, is accepted at the 1% level of significance in all equations. All variables have the correct signs in the two equations. Not surprisingly, HSIZE, PARR and DEPR are significant at the 1% level in the two equations while, EDUC, FMRW, PPRM, PLSTO and LHOL are significant at the 5% level. Empirically, we thus prove that socioeconomic and especially demographic variables have a significant impact on the income of households as well as on the reduction of poverty incidence in Pakistan in general and southern Punjab in particular.

Table-12: The Determinants of Rural Income Per Capita or Poverty: Log-Linear Regression Results of a Village Data, 2006

	Equation I		Equation II	
Variable Predictor	Coefficients	t-statistic	Coefficients	t-statistic
HSIZE	-0.06*	-2.36	-0.08*	-2.59
EDUC	0.05**	1.75	0.07**	1.78
PARR	0.72*	2.57	0.89*	3.05
FMRM	-0.04	-0.51	-0.04	-0.53
FMRW	0.17**	1.69	0.17**	1.75
DEPR	-0.38**	-1.71	-0.13*	-3.60
CDEPR	-28.06	-0.70	-	-
ODEPR	-28.00	-0.70	-	-
AGEH	0.006	0.29	0.029	1.00
$(AGEH)^2$	-0.00002	-0.07	-0.0001	-0.77
PPRM	-0.04***	-1.52	-0.05**	-1.67
VLSTO	0.001	0.86	0.001	1.18
PLSTO	0.09**	1.68	0.13**	1.80
VPAST	0.001	0.71	-	-
LHOL	0.18**	1.60	0.023**	1.69
Intercept	-0.57	-1.10	-0.88	-1.30
R^2	79.50		80.30	
Adjusted-R^2	75.25		78.90	
F-Statistic	24.81		37.63	
N	100		100	

Note: i. *Indicates that the coefficients are significant at the 1% level.
** Indicates that the coefficients are significant at the 5% level.
***Indicates that the coefficients are significant at the 10% level.

ii. A dash (-) refers to the situation where corresponding variables are dropped in the equation to reduce multicollinearity. Since child and old dependency ratios are the part of composite dependency ratio, the former are dropped to avoid multicollinearity.

Next we use a logistic regression as another and alternative econometric technique to analyze the main determinants of poverty in terms of some qualitative and quantitative variables. In particular, the purpose of the model is to determine the factors that explain the probability of being poor.

The logistic estimates of poverty determinants are reported in Table-13. The empirical results show that, except for FMRM, PLSTO and PASTH, all the coefficients in the regression are significantly different from zero at the 1 to 5% level of significance. HSIZE, DEPR, HHFM, HHLB and HHRS have an odds ratio of more than 1 which confirms their positive relation with the probability of being poor. On the contrary, the variables EDUC, FMRM, HHLT, PARR, AGEH, HVHC, HHFR, HHFL, LHOL, PLSTO, and PASTH all have odds ratios lower than 1, which means that these variables are negatively correlated with the probability of being poor.

The coefficient of HSIZE is statistically significant and has a positive sign. This implies that, with a decrease in household size, the probability of being poor will fall. The coefficient on the dependency ratio (DEPR) has a positive significant effect on poverty. The coefficient on educational attainment of households (EDUC) has a negative significant effect on poverty. This implies that the more educated an individual, the greater the potential to exploit resources and technology and avoid poverty. The coefficient of HHLT has a negative significant effect on poverty. This implies that literate households have a better chance of escaping poverty.

The participation ratio is the main component of household employment. The coefficient on PARR has a negative significant effect on being poor. It reveals that greater earnings will increase a household's income level, and that this tendency will directly alleviate poverty. Given that there is a joint family system in the rural areas of southern Punjab, the older a household head, the higher the household's earnings and accumulation of resources. This is proved empirically by the negative sign of AGEH. The coefficients of HHFR and HHFL also have a negative effect on poverty. Livelihood conditions affect the profile of poverty. The coefficient on HHRS has a positive significant effect on poverty and our result is in line with our hypothesis.

The majority of rural households are landless. The coefficient LHOL has a negative significant effect on being poor. The population of livestock plays a vital role in the rural areas of southern Punjab. Empirically, it is evident that PLSTO has a negative impact on poverty. Similarly, PASTH also has a negative relation with being a poor household. In this table, all variables have their expected signs. The results of the logistic analysis also support the results of income regression analysis.

Table-13: Logistic Estimates of the Determinants of Rural Poverty

Predictor	Coefficient	Z-statistic	Odds ratio
HSIZE	0.73*	2.54	2.47
DEPR	0.95*	2.59	2.59
EDUC	-0.28**	-1.96	0.79
FMRM	-0.07	-0.30	0.93
HHLT	-0.31**	-1.98	0.80
HHFM	1.11*	2.38	1.83
HHFR	-0.58**	-1.97	0.56
HHFL	-0.44**	-1.96	0.80
HHLB	0.35	0.68	1.12
HHRS	0.73**	1.98	1.57
PARR	-2.56*	-3.10	0.08
AGEH	-0.04*	-2.56	0.96
HVHC	-0.58**	-1.98	0.57
LHOL	-0.69**	-1.96	0.50
PLSTO	-0.03	-1.07	0.98
PASTH	-0.41	-1.17	0.66
Constant	2.14	1.69	-
Log-likelihood = -22.73			
Joint significance = 132.81, P = 0.000, n = 100			

Notes: * Indicates that the coefficients are significant at the 1% level.
** Indicates that the coefficients are significant at the 5% level.

V. Conclusions and Policy Implications

In this study, we have undertaken bivariate and multivariate analyses of household socioeconomic and demographic characteristics using data from a village located in southern Punjab. The various characteristics of poor households analyzed on the basis of FGT indices in a bivariate analysis suggest the following.

(I) It has been empirically proven that, as a household's landholdings increase, the three poverty measures, incidence, depth, and severity of poverty, decrease. This tendency shows the negative relationship between landholdings and incidence of poverty. The results also show that poverty incidence, depth, and severity are worse among landless households.

(II) A household size of 7-8 members was found to be most prone to poverty. On average, 8 and above members in a household imply the highest incidence, depth and severity of poverty. We have also concluded that an optimal household size is 3 members, as it experiences a lower depth and intensity of poverty.

(III) We have drawn a strong and significant relationship between educational attainment and rural poverty. Households with no educational attainment have the highest incidence, depth and severity of poverty. There is evidence that with a rising level of educational attainment, all three measures of poverty fall.

(IV) The evidence shows that better economic conditions are associated with greater participation rates and that poverty falls as the participation rate increases.

(V) The results also show that rural poverty was the result, as one might expect, of a high dependency ratio. Starting from the lowest dependency ratio, increasing dependency is correlated with higher of incidence of poverty, depth and severity of poverty. It also appears that the highest dependence ratios (which make up only one-third of the population) are associated with a lower level of incidence of poverty, depth and severity of poverty.

(VI) A lower female-male ratio of workers has a negative relation to incidence, depth and severity of poverty.

(VII) As far as the age of the household head is concerned, we have concluded empirically that the older the household head, the lower the incidence, depth and severity of poverty given his or her work experience. This situation might be because of the high dependency ratio and low participation rates among the households of southern Punjab.

The results of the two econometric models constructed to carry out the multivariate analysis of rural poverty are described below:

(I) In the income regression analysis, household size, education levels, participation rates, female-male ratio of workers, dependency ratio, persons per room, population of livestock, landholding, and age of household heads were found to influence the dependent variable (household income per capita) in a significant way. An empirical enquiry revealed that household size, female-male ratio of workers, dependency ratio, persons per room and age of household heads were found to be negatively related to a household's income per capita and indirectly positively related to poverty incidence. However, educational attainment level, participation rate, population of livestock and landholdings by households were found to be positively related to their income level and inversely related to poverty incidence.

(II) We now turn to an important and alternative technique: multivariate logistic regression models in analyzing the determinants of rural poverty. The evidence shows that household size, dependency ratio, the presence of a female household head, and residence in a ***kacha*** house was positively and significantly correlated with the probability of being poor. Variables that were negatively and significantly correlated with the probability of being poor were educational attainment of households, literate household head, whether the household head is a farmer or a farm laborer, participation ratio, age of household head, household visits to a health center, and landholdings.

Poverty alleviation efforts should be made through grassroots-level planning to raise both farm and nonfarm rural real incomes. This can be done through job creation, micro- and small-scale entrepreneurship, and the increased provision of formal and informal education and health facilities, safe drinking water, improved sanitation conditions and nutrition, better housing and a variety of related social and welfare services. Moreover, measures should also be adopted to improve the economic and social infrastructure in remote areas of Pakistan. Efforts should also be made to improve the social and especially demographic characteristics of households as these are found to be important reasons for poverty in a household. The government should also allot more land to landless households to reduce poverty in southern Punjab.

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The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 69-84

Economic Value of Irrigation Water: Evidence from a Punjab Canal

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Abstract

This study is based on data from a cross sectional survey of 120 farms located along the Mithaluck irrigation canal in central Punjab. The data collected were analyzed using (i) the residual imputation method, and (ii) the change in net income method, and applied to a linear programming model to estimate the value productivity of irrigation water. Returns to irrigation varied by farm size and location on the canal, but were generally found to be very high relative to the estimated delivery cost of irrigation water. The results of this study could prove useful in determining the economic feasibility of various resources for supplementing water and improving delivery and application efficiencies.

JEL Classification: A10, C20.

Keywords: Irrigation, value of water, residual imputation, Punjab, Pakistan.

Introduction

Pakistan's water resources include local rainfall, surface water from the Indus River and its tributaries, and extensive groundwater resources in the deep alluvial deposits of the Indus Plain. While irrigation has been utilized for thousands of years, the modern use of irrigation on the Indus River began in the middle of the nineteenth century. Subsequently, an intricate network of water control and distribution developed into one of the largest irrigation systems in the world. Most of Pakistan's agricultural production is carried out in the Indus Basin and draws on this extensive irrigation network, which comprises some 40,000 miles of conveyance channels (i.e., canals, branches, distributaries, and minor channels) and 112 principal canal systems spanning more than 100,000 watercourses. In

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addition, some 380 miles of large link canals have been constructed to connect the Indus River's tributaries. The combined diversion from the main canal system is nearly 114 billion cubic meters (bcm) (Government of Pakistan 2006). The total area served by the irrigation system within the Indus Plain amounts to 16.8 million ha. About 10.5 million ha of this area have perennial water supplies while the remainder receives only seasonal supplies, usually between mid-April and mid-October (Government of Pakistan 2006).

The strongest argument for not treating water as one might any other economic commodity is that its shortage does not determine its value. Water productivity is low in water-scarce countries or parts thereof, with the exception of rich economies that do not depend on agriculture. In Yemen for instance—one of the world's poorest countries in terms of water resources—water productivity and the performance of irrigation are among the lowest in the world. The same applies to poor regions of countries such as Jordan and the oases south of Egypt, as well as Tunisia, Algeria, Morocco, and Pakistan. In fact, water productivity seems to be lowest in the water-scarce regions of agriculture-based economies. Subsistence farmers bear the cost of water, such as pumping groundwater, to a certain extent. With the rising price of water, more and more "layers" of the poor are excluded, giving increasingly more of the nonpoor access to this resource. Thus, increasing the price of water is equivalent to creating inequities that favor the nonpoor/head farmers and discriminate against the poor/tail-end users.

The benefits of an irrigation system depend on the rules that govern it. For most of the twentieth century, water managers and engineers focused on building irrigation hardware, letting the development of rules ("software") lag behind. Flaws in an irrigation system's software design are easy to find. Large subsidies for irrigation are nearly universal, for instance: farmers receiving water from public projects rarely pay more than 20% of the real cost incurred and often far less. Less than 10% of the total recurring cost of large and medium irrigation projects built in the 1970s have been recovered in the Indus Basin (Postel 1999). Farmers in Tunisia, a country severely short of water, pay 5 cents per cubic meter for irrigation water—one seventh of what it costs to supply it. Irrigators in Jordan, one of the most water-strapped countries in the world, pay less than 3 cents per cubic meter, which is a small fraction of the water's total cost. According to one estimate, irrigation subsidies worldwide amount to USD33 billion per year. If the full costs of environmental damage, human resettlement from dam sites, and increased waterborne diseases from irrigation projects were to be factored in, the total subsidy tally would be much higher (Ahmad 2001).

Along with massive subsidies, another major disincentive to efficiency is the absence of accountability for how an irrigation system actually performs—a problem that is especially serious in developing countries. Irrigation fees, although low, often go to the national treasury rather than into funds earmarked for operating and maintaining the system. As a result, the fees that farmers pay often have no bearing on the upkeep and performance of their irrigation networks. The failure of governments and international donors to design institutions and rules that might ensure the efficiency, equity, and sustainability of irrigation systems has left a large unfinished agenda in irrigated agriculture. The most important consideration is institutional design, i.e., the process of framing a set of rules and regulations that irrigators understand, agree on, and are willing to follow.

The economic valuation of any water allocation policy depends on estimates of the economic value of water—a measure of the net economic contribution of water to the value of agricultural production. Empirical estimates of the value of irrigation water also provide important evidence of farmers' ability to pay for implementing cost recovery programs. Another increasingly important use of irrigation water valuations arises in connection with the analysis of economic tradeoffs among water-using sectors. Although many agricultural uses of water yield high economic returns, the lowest valued consumptive uses of water are typically located in the production of agricultural crops (Young 1995).

Estimates of the economic value of irrigation water are often erroneous because the valuation of irrigation water is more difficult and complex than is commonly recognized. Errors in estimates usually overstate than understate. The principal source of overstatement is crediting water with returns that should be allocated to other inputs, such as labor and, particularly, human capital (Young 1995).

Water scarcity looms large in the Indus Basin. Of the total canal diversion, nearly 35 bcm are consumed by crop production while 40% of water diverted from the river system is lost while being conveyed from the canal head to farm gates (Government of Pakistan 2006). This limited water supply suggests the importance of estimating the economic value of water to evaluate both structural and nonstructural methods of enhancing returns to a scarce resource. The marginal value product measures the incremental gains from the resource use, and can be compared with incremental cost to determine economic feasibility. Estimates of water resource productivity also provide a useful method for examining the efficiencies of the existing resource allocation, and aid in formulating national and provincial resource development policies. In Pakistan, however, there are no reliable estimates

of the economic value of water. Farmers are charged a flat rate which hardly covers the cost of operation and maintenance (O&M). Above all, the irrigation system is neutral in terms of allocation. Estimating the value of water is thus imperative for providing useful information to irrigation managers and policymakers.

While previous studies have tended to use secondary data and lacked empirical content, this study is based on survey data for an Indus River distributary, which adds empirical rigor. Moreover, the study focuses on the position (head or tail) of farmers served by the distributary. Unlike earlier studies, the objective here is to estimate the economic value of water, using both (i) the residual imputation method, and (ii) change in net income (CINI) method to evaluate water charges. The study also simulates different scarcity scenarios, which previous studies have not done. Estimating the economic value of water is cumbersome because water is not a traded input. Accurate estimates of its economic value have important policy implications.

2. Data and Methodology

A sample of 120 farmers was used to collect information on the farm budgets of various crops. The data included but was not limited to the cost of all inputs, price of output, yield, and water applications. Of the total sample, subsamples of 30 farmers each were used to represent small, large, and head- and tail-enders on the Mithaluck distributary in Sargodha. A farm budget for crops and farm level was developed to carry out a partial budget and economic analysis for each category of farmer. The same farm budget was used to construct a linear programming (LP) matrix to evaluate four models, namely, (i) small, (ii) large, (iii) head, and (iv) tail farms. Labor and water inputs were taken for a full crop calendar of 12 months to evaluate various scenarios. The two approaches used to estimate the economic value of water used are discussed below.

2.1. Residual Imputation Approach

The "residual" method is most commonly applied to shadow pricing irrigation water and other producers' goods. Broadly, it determines the contribution of each input to output in the production process. If appropriate prices can be assigned—presumably by market forces—to all production inputs but one, the remaining total value of product is imputed to the remaining or residual resource (Heady 1952).

Derivation

The derivation requires two principle postulates. First, a well-known requirement of competitive equilibrium is that the prices of all resources are equated to returns at the margin (for each resource i, $P_i = VMP_i$). Profit-maximizing producers are assumed to add productive inputs to the point that value marginal products are equal to the opportunity cost of the inputs.

The second postulate requires that the total value of product be divisible into shares so that each resource is paid according to its marginal productivity and the total value of product is thereby completely exhausted. According to Euler's Theorem, the total value of product will be exactly exhausted by the distributive shares, but only in the event that its function is homogeneous in the first degree (Heady 1952, Debertin 1986). We shall assume that these postulates adequately represent actual agricultural production conditions.

Now consider an agricultural production process in which a single product denoted Y is produced by four factors of production: capital (K), labor (L), natural resources, such as land (R), and irrigation water (W).

$$Y = f(K, L, R, W) \tag{1}$$

We may write by the second postulate:

$$TVP_Y = (VMP_k Q_k) + (VMP_L Q_L) + (VMP_R Q_R) + (VMP_W Q_W) \tag{2}$$

Where TVP represents total value of product Y, VMP represents value marginal product of resource i, and Q is the quantity of resource i.

If competitive factor and product markets can be assumed, prices can be treated as known constants. The first postulate (which asserts that $VMP_i = P_i$) permits substituting into (2) and by rearranging:

$$TVP_Y - P_k Q_k + P_L Q_L + P_R Q_R = P_W Q_W \tag{3}$$

Assuming that all variables in (1) are known except P_W, the expression can be solved for that unknown to impute the shadow price of water P_W^* as follows:

$$P_W^* = (TVP_Y - P_K Q_K + P_L Q_L + P_R Q_R)/Q_w \tag{4}$$

Equation (2) can, of course, be generalized to encompass cases in which input categories are further disaggregated. For example, capital (K)

can be divided into various classes of durable or nondurable factors, or labor (L) into field and managerial work.

Potential Problems in the Application of the Residual Method

The assumptions underlying residual imputation are not overly restrictive, but care is required to assure that the conditions of production under study are reasonable approximations of the conceptual model. The main issues can be divided into two types: (i) those relating to the specification of the production function, and (ii) those relating to the market and policy environment, i.e., the pricing of outputs and nonresidual inputs (Young 1985). Problems include specifying the production function, assigning prices to inputs and outputs: measuring and pricing inputs and output, and the case of costing nondurable capital, durable capital, labor, and human effort. Another opportunity for overestimating returns to water is the proportion of acreage devoted to high-value crops in the long term. Some economists contend that, in most cases, any specialty crop production that occurs on a new irrigation project is likely to have merely displaced production elsewhere in the country.

2.2. LP Model

CINI Method

The additional income from a crop or farm was defined as the difference between net incomes "with" or "without" irrigation improvement models (small, large, head, and tail) developed on the Mithaluck distributary in the Indus Basin. This demonstrates the "with or without" principle for irrigation improvement and derivation of water charges (CINI).

In practical applications, irrigation water is often valued using the CINI method. The willingness to pay for an increment in water is the net producer's income associated with that increment. A process similar to that used for residual imputation can represent this approach. It is designed to accommodate the case of a multi-product firm in addition to the individual crop model discussed above.

A more general multi-crop/multi-input production function can be written as

$$f(Y_1,.....Y_m; X_1,.....X_n) = 0 \qquad (5)$$

Where Y is a vector of outputs for feasible crops and X a vector of production inputs. The net income (Z) from producing a given set of crops can be represented by

$$Z = \sum_{i=1...m} (Y_i P_{yi}) - \sum_{j=1...n} (X_j P_{xj}) \quad (6)$$

The CINI is

$$\Delta Z = Z_1 - Z_0 \quad (7)$$

Where the subscripts 0 and 1 refer to the "without project" and "with project" situations, respectively.

Note that if land is the only residual claimant in the net income expression (6) (as it would be if the "without project" situation involved rain-fed cropping), then (6) is reduced to the residual imputation formula given in (4) above. In other words, Z_0 represents the opportunity cost of the residual claimant, land in the "without project" situation.

3. Results and Discussion

3.1. Residual Imputation Method

The residual imputation method described as above was applied to estimate the economic value of water for all four farm categories as shown in Table-1 (see the appendix to this article for a detailed budget analysis).

Table 1: Economic Value of Irrigation Water by Crop and Farm Category, Mithaluck Distributary, Sargodha

Crops	Small Farms (Rs/m^3)	Large Farms (Rs/m^3)	Head Farms (Rs/m^3)	Tail Farms (Rs/m^3)
Cotton	2.32	3.49	2.71	1.87
Maize	1.13	1.17	0.51	0.98
Rice	1.30	1.17	0.76	1.39
Sugarcane	0.91	1.95	0.50	0.80
Wheat	1.51	0.90	0.70	1.06
Citrus	1.65	1.41	1.13	1.09

The analysis reveals that the economic value of water for all crops is very high and that current water rates—Rs0.004 per cubic meter for *rabi* (winter) crops and Rs0.006 per cubic meter of *kharif* (summer) crops

(Government of Punjab 2005)—fall far below its scarcity value. This shows that irrigation water is undervalued, leading to the inefficient use of a vital resource. The results of the study are consistent with Ahmad (2001), where the economic value of water is estimated at Rs121 per acre inch for wheat, Rs57 for rice, Rs26 for cotton, and Rs66 for sugar cane. The estimated marginal value product (MVP) of water is Rs148-226, i.e., many times higher than current water rates (kharif, Rs85, and rabi, Rs50). As indicated in the previous section, water charges evaluated at opportunity cost (sale of tube-well water at Rs100/acre inch) can safely be increased by 20% without a significantly negative effect on the objective function of the models estimated.

First, water prices cannot, for instance, be feasibly increased to the point where they start to affect water use and demand. Second, low water prices are frequently not the reason for water-intensive and inefficient crop choices. Thus, there is need to enforce allocation rules on existing canals which could in turn induce farmers to use less water and lead to a scarcity value reflecting its proper use.

The above analysis showed that estimated water charges are much higher than actual charges. This calls for a corrective policy measure by increasing water charges to an appropriate level in each of the above scenarios. The Government of Pakistan has either been providing subsidized irrigation water or deferring maintenance: neither case augurs well. Subsidies encourage the misallocation of water and become a burden on the exchequer of a resource-poor country, while deferred maintenance deteriorates the irrigation system much faster.

3.2. CINI Method

The CINI method can be adapted to mathematical programming models (the LP model) of farm situations to approximate a functional relationship between net benefits and irrigation water use (Burt 1964, Bowen and Young 1985, Chaudhry and Young 1989).

The programming model of a representative farm situation was formulated to maximize the net return to the residual claimant (the water resource in this case) subject to constraints on water availability. The model is solved for each of a number of increments in water supply and the net return to each increment of water derived from the incremental change in the objective function. The derivation of the marginal value product of water is shown through LP models.

The value of irrigation water can be derived through shadow prices in an LP model where water is the most constrained input. The basic

concept for establishing shadow prices is the notion of willingness to pay as an indicator of value. Willingness to pay reflects a consumer's willingness to forego other consumption rather than do without the commodity in question. In accordance with the postulates of diminishing marginal productivity or utility, willingness to pay falls as increasing quantities are utilized. The measure of willingness to pay indicated by conventional wisdom is commensurate with market value and is an indication of exchange value. The technique for determining shadow prices (for an un-priced input, in this case irrigation water) is called the "residual imputation." This has already been discussed above. An extension of this procedure, the CINI method applied to an LP model, provides a useful tool for deriving the CINI for further derivation of the value of water.

Table-2: Economic Value of Water on Small Farms (CINI) on Mithaluck Distributary, Sargodha

Model	Irrigation Water (m^3/acre)	Farm Net Income (Rs)	Δ in Irrigation (m^3)	Δ in Net Income (Rs)	Δ Net Income/Δ Irrigation (m^3)
Original farm model	23,952.20	35,152.9	-	-	-
10% water discount	21,556.98	27,419.3	2,395.22	7,733.6	3.23
20% water discount	19,401.28	20,948.3	2,155.70	6,471.0	3.00
30% water discount	17,461.15	15,816.0	1,940.13	5,132.3	2.65
40% water discount	15,715.04	11,703.8	1,746.12	4,112.2	2.36
50% water discount	14,143.53	8,660.8	1,571.50	3,043.0	1.94
60% water discount	12,729.18	6,322.4	1,414.35	2,338.4	1.65

Figure 1: Economic Value of Water on Small farm at Mitha Luck Distributory

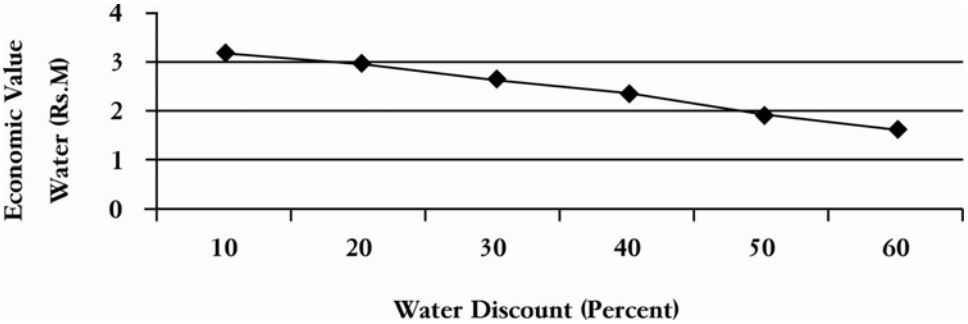
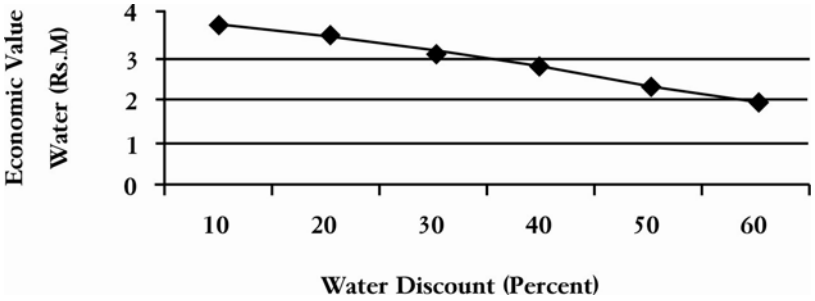


Figure 2: Economic Value of Irrigation water on large farm at MItha Luck Distributory



3.3. Model Results

The model results obtained are given in Tables 2 to 5. The results reveal that the economic value of water at discounted water availability varies from Rs1.63 to Rs3.23 per cubic meter on a small farm. The economic value of water was Rs1.63 per cubic meter even at a 60% water discount. In the case of large farms, the value varied from Rs1.93 to Rs3.76 per cubic meter for various discount scenarios; even under conditions of extreme stress, the economic value of water was Rs1.93 per cubic meter. In the case of head farms, the value varied from Rs1.03 to Rs2.01 per cubic meter, and from Rs1.39 to Rs2.74 per cubic meter at tail-end farms. Figure 1 shows the declining trend of the economic value of water per cubic meter under different water scarcity scenarios. It is interesting to note that, even under conditions of extreme scarcity and water stress, farms maintain their paying capacity. The economic value of water determined using both methods was almost the same. Thus, Indus farmers have the capacity to pay for irrigation water, the value of which can be increased manifold based on the economic value of water.

In summary, the economic value of water varies between Rs1 and Rs3 per cubic meter both for individual crops and farm categories. The allocative efficiency criteria for the irrigation input warrants that the MVP of water must be equal to its price (opportunity cost) for efficient utilization. In the present case, the economic value of water or MVP of irrigation is much higher than its market price (opportunity cost). The existing water charges are Rs50 per acre for rabi crops and Rs85 per acre for kharif crops—both charges are extremely low and hardly cover the cost of O&M of irrigation. The consumptive use of sugarcane is nearly 5,500 cubic meters and that of wheat, 1,800 cubic meters. On the basis of consumptive use, the economic value of sugarcane is estimated at Rs5,000-6,000 per acre; that of wheat, Rs2,000-2,700 per acre. Comparing current water charges with the economic value of water for both crops showed that water charges can be increased manifold to recover O&M costs. The Punjab government's Irrigation Department has a budgeted expenditure of Rs16 billion, of which 44% is current expenditure and 56%, development costs (Government of Punjab 2005). Of the 44% of current expenditure, only 30% was spent on O&M, implying that the current flat rate per season hardly covers maintenance costs. Even the revenue collected through water charges goes to the government treasury and is not targeted to canal maintenance. Keeping in view the scarcity of water and deterioration of the irrigation system, the government needs to consider a paradigm shift to bring about institutional changes in managing the canal system. Engineering solutions to water do not serve the purpose. Therefore, canal management should include agronomic, economic, and social consideration in allocating water. Water charges should reflect the scarcity of irrigation water.

Table-3: Economic Value of Water on Large Farms (CINI) on Mithaluck Distributary, Sargodha

Model	Irrigation Water (m^3/acre)	Farm Net Income (Rs)	Δ in Irrigation ($m^{3)}$	Δ in Net Income (Rs)	Δ Net Income/Δ Irrigation (m^3)
Original farm model	3,0685.50	52,444.1	-	-	-
10% water discount	27,616.95	40,906.4	3,068.55	11,537.7	3.76
20% water discount	24,855.26	31,252.5	2,761.70	9,653.9	3.50
30% water discount	22,369.73	23,595.6	2,485.53	7,656.9	3.08
40% water discount	20,132.76	17,460.8	2,236.97	6,134.9	2.74
50% water discount	18,119.48	12,921.0	2,013.28	4,539.8	2.25
60% water discount	16,307.53	9,432.3	1,811.95	3,488.7	1.93

Figure 3: Economic value of Water of Head farm at Mitha Luck Distributory

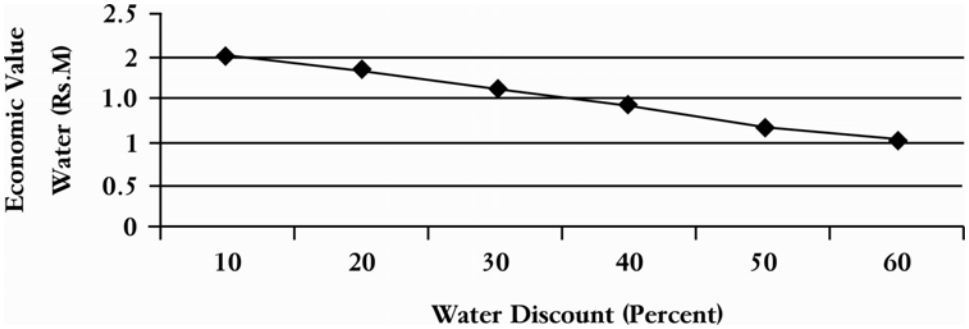


Figure 4: Economic Value of Water of Tail farm at Mitha Luck Distributory

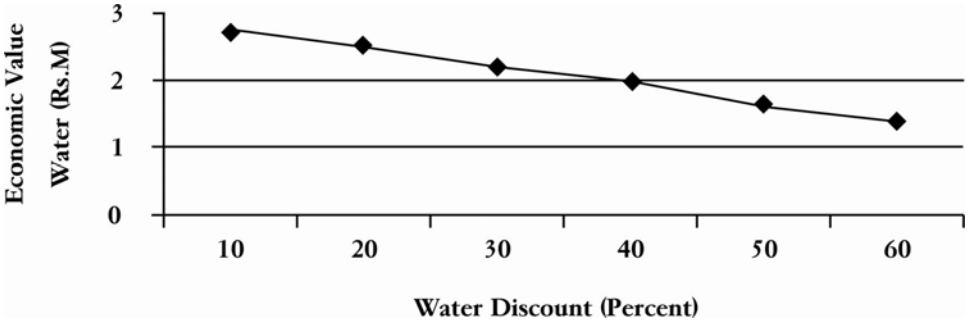


Table-4: Economic Value of Water on Head Farms (CINI) at Mithaluck Distributary, Sargodha

Model	Irrigation Water (m^3/acre)	Farm Net Income (Rs)	Δ in Irrigation ($m^{3)}$	Δ in Net Income (Rs)	Δ Net Income/Δ Irrigation (m^3)
Original farm model	32,620.50	29,756.9	-	-	-
10% water discount	29,358.45	23,210.4	3,262.05	6,546.5	2.01
20% water discount	26,422.61	17,732.8	2,935.85	5,477.7	1.87
30% water discount	23,780.34	13,388.2	2,642.26	4,344.5	1.64
40% water discount	21,402.31	9,907.3	2,378.03	3,480.9	1.46
50% water discount	19,262.08	7,331.4	2,140.23	2,575.9	1.20
60% water discount	17,335.87	5,351.9	1,926.21	1,979.5	1.03

Table-5: Economic Value of Water on Tail farm (CINI) at Mitha Luck Distributory, Sargodha

Model	Irrigation Water (m^3/acre)	Farm Net Income (Rs)	Δ in Irrigation ($m^{3)}$	Δ in Net Income (Rs)	Δ Net Income/Δ Irrigation (m^3)
Original farm model	20,772.00	25,551.5	-	-	-
10% water discount	18,694.80	19,930.2	2,077.20	5,621.3	2.71
20% water discount	16,825.32	15,226.6	1,869.48	4,703.5	2.52
30% water discount	15,142.79	11,496.1	1,682.53	3,730.5	2.22
40% water discount	13,628.51	8,507.1	1,514.28	2,989.0	1.97
50% water discount	12,265.66	6,295.3	1,362.85	2,211.9	1.62
60% water discount	11,039.09	4,595.5	1,226.57	1,699.7	1.39

4. Conclusions and Recommendations

The study's most striking finding is that, on most farms, the economic value of water is very high relative to incremental cost. The results, both by crop and farm category, show that farmers have paying capacity even under high stress conditions. The highest value attributed to water was on large and head farms. Estimates of the economic value of water show that there is more than enough room to increase water charges to cover O&M costs and reflect resource scarcity.

The engineering approach to canal management has outlived its utility, and irrigators must be assigned the task of managing this vital resource. Once irrigators are persuaded that they will be ensured a supply of water, they will be more than willing to pay on the basis of the MVP of water. Water allocation rules need to be revisited and made demand-driven while phasing out supply-oriented approaches to water delivery. Policymakers should focus on irrigation agronomy and look for soft rather hard solutions in order to efficiently manage this key resource.

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Appendix: LP Matrix for Large Farms on Mithaluck Distributary, Sargodha

Activity	Cotton	Wheat	K. Fodder	Sugarcane	R. Fodder	Rice	Maize	Citrus	Wheat+ Citrus	Berseem +Citrus	RHS
Obj.(Rs)	19805	10846	3848	32217	12433	16625	12084	38000	39500	36500	
Land (Acres)											
Kharif	1		1	1		1	1	1	1	1	≤32
Rabi		1		1	1			1	1	1	≤32
Labor (Person-Days)											
Jan		0.64		15.72	9.37		4.94	5.31	5.85	15.62	≤150
Feb		0.54		18.86	9.37		4.92	5.31	8.83	15.25	≤150
March		0.59		0.79	9.37		5.48	8.24	14.45	20.15	≤150
April		4.0	3.18	0.79	11.25		0.79	10.45		14.00	≤150
May			0.79	0.79	0.79						≤150
June	1.84		5.31	3.3		3.3	3.3	3.3			≤150
July	2.30		5.31	0.79		0.79	0.79	0.79			≤150
August	3.23		3.18	7.07		079	079	0.79			≤150
Sept	4.61			0.79		2.30	2.30	2.31	8.66		≤150
Oct				4.39	1.5	3.5	2.41	2.41	12.92		≤150
Nov		2.19		0.79	6.25	3.93	3.23	5.42	5.16		≤150
Dec		0.54		0.79	7.5		4.92	4.63	6.24	15.00	≤150
Water (Acre-Inches)											
Jan		2.82		2.32	7.61		4.23	2.3	2.3	2.0	≤62.67
Feb		2.82		3.86	4.57		2.51	3.5	3.5	3.5	≤76.99
March		2.82		3.46	1.53		0.85	2.0	2.0	2.0	≤102.64
April		0.94		3.46				1.5	1.5	1.5	≤102,64
May			2.41	3.46				4.0	4.0	4.0	≤102.46
June	2.78		2.41	4.15				4.0	4.0	4.0	≤128.34
July	2.78		2.41	4.63				5.0	2.3		≤128.34
August	2.78		1.2	4.63				5.0	3.5		≤102.64
Sept	2.78			4.63			5.07	4.0	3.0		≤129.23
Oct				4.63	9.11		5.07	3.0	3.5	4.0	≤98.01
Nov		3.29		3.86	9.11			4.0	4.0	4.0	≤80.44
Dec		2.82		1.54	9.11			5.0	4.0	4.0	≤57.74
N (NKg)	21.62	22.77		23.99	11.50	52.0	23	56	36	31	≤1000
P (NKg)	32.37	20.64	0.0	33.98	10.33	22.00	17	45	49	45	≤500

Continued Appendix I

Buy	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	N	P	W
Labor (Rs)	90	90	90	90	90	110	110	90	90	90	90	90			
Fertilizer (Rs./NKg)	-	-	-	-	-	-	-	-	-	-	-	-	19.30	45.32	
Water Rs/Acre Inch)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100

The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 85-113

Cointegration and Causality: An Application to Major Mango Markets in Pakistan

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Abstract

Mangoes are one of Pakistan's most important fruits; the country is the world's fourth largest producer and exporter of mangoes. Integrated markets are those where price signals are transferred from one to another, allowing physical arbitrage to adjust any disturbances in these markets; integrated markets are thus a sign of efficiency. From this viewpoint, we investigate domestic integration among ten major mango markets, i.e., Lahore, Faisalabad, Multan, Gujranwala, Sargodha, Karachi, Hyderabad, Sukkur, Peshawar, and Quetta employing Johansen's cointegration approach and error correction model. Data on monthly wholesale prices data (PRs/100 kg) were obtained from the agricultural and livestock marketing advisor, Government of Pakistan. The results of the study confirm the presence of integration among major mango markets in Pakistan. These markets were able to adjust for 16 to 68% of disequilibrium in one month, implying that it takes almost two to six months to remove any disequilibrium and to move back to long-run equilibrium. The Granger causality test shows that the Karachi market has bidirectional causality with Lahore, Faisalabad, Multan, Hyderabad, and Sukkur, and a unidirectional relationship with the rest. An impulse response analysis was also conducted to check the stability of these markets given a standard error shock to the Karachi base market.

JEL Classification: A10, C01.

Keywords: Mangoes, cointegration, causality, Pakistan.

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Introduction

Fruits are an important sector of Pakistan's agricultural economy. They are valued as a rich source of minerals and vitamins providing more energy per unit weight than cereals. An increasing trend in population and changing consumer behavior toward a more balanced diet has increased the demand for fruit. Pakistan has a wide range of agro-climatic conditions, which allow the production of a variety of tropical and subtropical fruits. Among the major fruits of Pakistan, mangoes occupy the second position, coming after citrus fruits in terms of area and production: 192,000 ha of land (2,458,000 tonnes) are under citrus fruit cultivation and 156,000 ha (1,753,000 tonnes) under mangoes (Government of Pakistan 2005/06). While there is much emphasis on the area and production of mangoes in Pakistan, relatively little is known about how price transmission takes place in domestic mango markets. Such information is important for mango producers and other mango value chain role players since it affects their marketing decisions (buying and selling), which in turn affect decisions related to logistical matters and eventually the export potential of mangoes from Pakistan.

In a market-driven economy, the pricing mechanism is expected to transmit information to determine the flow of marketing activities. Pricing signals guide and regulate production, consumption, and marketing decisions over time, form, and place (Kohls and Uhl 1998). Identifying the causes of price differences in interregional or spatial markets has therefore become an important economic analytical tool to better understand markets.

In developing economies, there are several impediments to the efficient functioning of markets, particularly agricultural commodity markets. These include inappropriate transportation infrastructure, difficulties in access to market information, government-imposed restrictions on the movement of goods between regions, government monopoly over the marketing and distribution system, and poor enforcement of anti-trust regulations that result in price fixing and oligopolistic market structures. If markets are not well integrated then price signals can become distorted, leading to the inefficient allocation of resources. The marketable surplus generated by farmers could then result in depressed farm prices and diminishing income (Tahir and Riaz 1997).

Spatial market integration refers to co-movements or the long-run relationship among prices. It is defined as the smooth transmission of price signals and information across spatially separated markets (Golleti, et al 1995). Two trading markets are assumed integrated if price changes in one

market are manifested in an identical price response in the other market (Barrett 1996). Market integration can also be defined as a measure of the extent to which demand and supply in one location are transmitted to the other (Negassa et al 2003).

Market integration can be measured in terms of the strength and speed of price transmission between markets across various regions of a country. If markets are not well integrated, this often indicates the presence of either government policies or infrastructural and institutional bottlenecks that interfere with the efficient flow of goods and prices between markets. With market reforms, market integration is expected to increase, reflecting a more rapid and effective transmission of price signals between markets (Goletti and Babu 1994). Thus, market integration can be a good way of enhancing market efficiency through price stabilization, which may trickle down further to other markets.

We have focused on estimating empirically the degree of integration among major domestic mango markets in Pakistan. The paper is organized as follows: Section 2 reviews the existing literature on agricultural prices, Section 3 discusses the empirical approach we have used, Section 4 presents data and results, and Section 5 concludes the paper.

2. Review of Literature

Agricultural prices are used as a major policy tool in developing countries to change levels of production. Developing countries are often characterized by intensive government interventions to regulate their economies, seldom allowing free market forces to operate. Agricultural price trends can be a good indicator of market efficiency. Previously, price correlation coefficients were used to investigate whether or not markets were linked by price changes (Lele 1971, Blyn 1973, Timmer 1987, Dadi et al 1992). However, price correlation coefficients can be misleading due to the presence of trends (nonstationary data) in the data (Wyeth 1992). Regression analysis has also been used to analyze integration (Alexander and Wyeth 1994). This practice was modified using price variables in their first difference form, but this caused the loss of long-run information. Cointegration, on the other hand, allows a way of dealing with time series data that avoids spurious results, thus enhancing the authenticity of research findings. Johansen's approach to cointegration is now used widely to test the level of integration among markets.

Although fruits are an important component of Pakistan's agricultural economy, there has been little effort to investigate the pricing

behavior of these crops. The existing literature includes studies on market structure, conduct, and margin analysis to evaluate the marketing efficiency of fruit crops in Pakistan (Scarborough and Takur 1973, Hays and McCoy 1977, Adekanaya 1982, and Kydd 1992).

Studies that focus on the pricing behavior of mangoes include Siddique (1977, 1979), Memon (1978), Khan (1980), Mohy-ud-din (1989), Khushk (1997), Khushk and Smith (1996), Lashari (1995), Khushk (2003), and Sharif (2004). Conducted in different parts of the country, most of these studies have used primary data to investigate pricing trends. The first three observe prevailing pricing practices to find the difference between farmers' and retail-level prices and thus estimate the level of marketing efficiency. Mohy-ud-din (1989) focuses on the export potential of mango and citrus fruits and examines price determination and its effect on the export potential of these fruit crops in Pakistan. Khushk (2003) conducts his study primarily on the mango crop to test the level of market integration using monthly average prices to calculate price correlation coefficients. Although the study shows that mango markets in Pakistan are integrated, it is limited in terms of the presence of trends in the dataset, which the authors do not tackle.

Sharif (2004) uses the weekly wholesale price of citrus fruits from four wholesale markets in Punjab for the period 1983 to 2003 to investigate the price relationships between these markets. The major findings of this analysis show that the Sargodha market is relatively better integrated with Faisalabad and Lahore than Multan since the price coefficient for the source market is greater than unity. However, the statistical test for integration reveals that the Lahore and Faisalabad markets were poorly integrated with Sargodha.

In addition to the literature on price behavior of the mango market, some literature examines the market integration of other major crops in Pakistan, i.e., Mushtaq et al (2006), (2007a), (2007b) (wheat, cotton, and rice); Mukhtar and Tariq (2008) (maize); and Lohano and Mari, (2006) (onions and potatoes). These studies use monthly average wholesale prices and test the level of market integration employing Johansen's approach. They find that markets are integrated in the long run, which provides a rationale for allowing market forces to operate freely in the country, leaving little reason for government interventions.

3. Empirical Methodology

The concept of cointegration (Granger 1981) and methods of estimating a cointegrated relation or system (Engle and Granger 1987; Johansen 1988, 1991, 1995) provide a framework for estimating and testing for long-run equilibrium relationships between nonstationary integrated variables. Time series data are often nonstationary which, if regressed, provide spurious results that can be misleading. The first step in dealing with time series data is to test for the presence of a unit root in the individual time series of each model. The augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1981), both with and without a deterministic trend, was used for this purpose. The number of lags in the ADF equation are chosen to ensure that serial correlation is absent, using the Breusch-Godfrey statistic (Greene 2000, p. 541). The ADF equation is required to estimate the following using the ordinary least squares (OLS) method.

$$\Delta P_t = \alpha_3 + \beta_3 t + (\phi_3 - 1) P_{t-1} + \sum \theta_t \Delta P_{t-1} + \mu_t \qquad (1)$$

Where P_t is the series under investigation and μ_t is the error term. If two series are integrated of the same order, Johansen's (1988) procedure can be used to test for the long-run relationship between them. The approach adopted in this paper is based on Sims' (1980) methodology of a general unrestricted vector autoregressive (VAR) model where, unlike single equation methods, the exogenity of one price is not imposed ex ante; long-run market integration is examined using Johansen's cointegration procedure.

$$X_t = \delta + A_1 X_{t-1} + A_2 X_{t-2} + \ldots\ldots + A_{p-1} X_{t-p+1} + \varepsilon_t \qquad (2)$$

Where X_t is an (n x 1) vector of endogenous variables, δ is an (n x 1) vector of parameters, A_i represents (n x n) matrices of parameters, and ε_t is an (n x 1) vector of random variables. In this model, the price series for the ten major mango markets were endogenous variables and as such no exogenous variable was used. To test the hypothesis of integration and cointegration in equation (2), we transform it into its vector error correction form.

$$\Delta X_t = \mu + \Gamma 1\, \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots\ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \pi X_{t-k} + \varepsilon_t \qquad (3)$$

Where $x_t = [P_{1t}, P_{2t}]'$, vector of endogenous variables, which are I(1), $\Delta x_t = x_t - x_{t-1}$, μ is a (2×1) vector of parameters, $\Gamma_1, \ldots, \Gamma_{k+1}$ and π are (2×2)

matrices of parameters, and ε_t is a (2×1) vector of white noise errors. Where π is of a reduced rank, that is $r \leq 1$, it can be decomposed into $\pi = \alpha\beta'$ and when r=1, $\alpha=[\alpha_1, \alpha_2]'$ is the adjustment vector and $\beta=[\beta_1, \beta_2]'$ is the cointegrating vector. In this case, the above mentioned equation can be rewritten as equation (4):

$$\begin{bmatrix}\Delta P_{1t}\\ \Delta P_{2t}\end{bmatrix} = \begin{bmatrix}\mu_1\\ \mu_2\end{bmatrix} + \sum_{i-1}^{k-1}\begin{bmatrix}\Gamma_{i,11} & \Gamma_{i,12}\\ \Gamma_{i,21} & \Gamma_{i,22}\end{bmatrix}\begin{bmatrix}\Delta P_{1t-i}\\ \Delta P_{2t-i}\end{bmatrix} + \begin{bmatrix}\alpha_1\\ \alpha_2\end{bmatrix}[\beta_1 \quad \beta_2]\begin{bmatrix}P_{1t-k}\\ P_{2t-k}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\end{bmatrix}$$

Harris (1995, p. 96) holds that there are three realistic models (denoted as models 2-4) implicit in the above equation. Model 2 shows no linear trends in the levels of the endogenous I (1) variables and the first-differenced series have zero means; here, the intercept is restricted to the cointegration space. Model 3 shows linear trends in the levels of the endogenous I (1) variables and there is an intercept only in the short-run model. Model 4 does not account for any long-run linear growth and shows a linear trend in the cointegration vectors. The Pantula principle (Harris 1995, p. 97) is used to test the joint hypothesis of both rank and deterministic components (Johansen 1992).

Even when cointegration has been established within the series, there may still be disequilibrium in the short run, i.e., price adjustments across markets may not happen instantaneously; markets can take time to adjust. Another important implication of cointegration and the error correction representation is that cointegration between two variables implies the existence of causality (in the Granger sense) in at least one direction (Granger 1988). Nevertheless, if two markets are integrated, the price in one market, P_1, would commonly be found to Granger-cause the price in the other market, P_2 and/or vice versa. Therefore, Granger causality provides additional evidence as to whether and in which direction price transmission is occurring between two series. If the series P_{it} and P_{ij} are I (1) and cointegrated, then the ECM model is represented by the following equations.

$$\Delta P_{it} = \alpha_0 + \sum_{t=1}^{n}\beta_i \Delta P_{(t-1)i} + \sum_{t=1}^{n}\beta_j \Delta P_{(t-1)j} + \delta ECT_{t-1} + \mu_t \qquad (5)$$

$$\Delta P_{jt} = \varphi_0 + \sum_{t=1}^{n}\sigma_j \Delta P_{(t-1)j} + \sum_{t=1}^{n}\sigma_i \Delta P_{(t-1)i} + \lambda ECT_{t-1} + \varepsilon_t \qquad (6)$$

Where Δ is the difference operator, P_{jt} is the price series in the Karachi market (i=1), P_{ij} is the price series in other markets (j=2. . . . . 10) μ_t and ε_t are white noise error terms, ECT_{t-1} is the error correction term (adjustment vector) derived from the long-run cointegrating relationship, while n is the optimal lag length orders of the variables which are determined by using the general-to-specific modeling procedure (Hendry and Ericsson 1991). The null hypotheses are: P_{it} will Granger-cause P_{jt} if $\mu_t \neq 0$. Similarly, P_{jt} will Granger-cause P_{it} if $\varepsilon_t \neq 0$. To implement the Granger causality test, F-statistics are calculated under the null hypothesis that all the coefficients of μ_t and $\varepsilon_t = 0$.

An impulse-response approach can also be used to derive additional information about the dynamic interrelationships among prices. Impulse-response analysis is employed to investigate the mechanism of shocks. This concept has been used to analyze the impact of price shocks and the way in which shocks are transmitted among market prices. It is based on the foundation that the economy's dynamic behavior can be well explained by random impulses generated over time by a constant linear structure. Potter (1998) improved the standard linear technique of an impulse-response function analysis to the non-linear case by defining a generalized impulse-response function as a random variable in the underlying space of the time series. In our study, an impulse-response function is estimated as an attempt to come to a better understanding of the dynamic price interrelationships, how price shocks are transmitted, and how long it takes for shocks to be eliminated in alternate markets.

4. Data and Results

We have used monthly wholesale price (Rs/100 kg) data for mangoes for the period June 1990 to July 2006 in logarithmic form. Data were obtained from the agricultural and livestock marketing advisor, Government of Pakistan. The study analyzes price transmission in ten selected mango markets in Pakistan: Quetta, Peshawar, Lahore, Faisalabad, Multan, Sargodha, Gujranwala, Karachi, Sukkur, and Hyderabad. The criteria for selecting these markets include net market positions (surplus or deficit area), geographical distribution, data availability, and the volume of trade or importance of the market to the national mango trade flow and their link to and importance in the export of mangoes. Karachi, as the largest market, was set as base market for the analysis.

Summary statistics are presented in Table-1, which shows that the minimum values of the average price varied from Rs800/100 kg in the Faisalabad market to Rs.1,150/100 kg in the Quetta market; maximum values for the average price varied from Rs.2,790/100 kg in the Hyderabad market to Rs.3,450/100 kg in the Quetta market. Average prices were found to be Rs.2,023/100 kg in Karachi, Rs.2,028/100 kg in Peshawar, Rs.1,764/100 kg in Multan, and Rs.1,851/100 kg in Faisalabad. The maximum standard deviation in price was in Karachi, which remained 574; the minimum standard deviation was 430 in Hyderabad.

Table-1: Description of Data (Rs. /100Kgs)

Market	Minimum	Maximum	Mean	Std. Deviation
Lahore	1,050.00	3,350.00	1,971.1569	555.8871
Faisalabad	800.00	3,000.00	1,851.5490	522.1870
Sargodha	923.00	2,950.00	1,912.3725	572.7451
Multan	1,062.00	2,800.00	1,764.5882	437.1369
Gujranwala	950.00	2,900.00	1,949.6471	503.9044
Karachi	1,070.00	3,370.00	2,023.7451	574.1763
Hyderabad	1,052.00	2,790.00	1,747.3922	430.8972
Sukkur	943.00	2,920.00	1,917.3725	553.5545
Peshawar	1,110.00	3,410.00	2,028.8039	553.0736
Quetta	1,150.00	3,450.00	2,071.1569	555.8871

The appendix at the end of this paper includes graphs of the price series. An increasing trend was found in the data over the time, which remained consistent for the said time period. Prices were found to be high at the beginning of each season, then decreasing in the middle, and rising again at the end: this trend seemed common for all major mango markets (see graphs). The consistent behavior of prices left little justification for any structural break in the dataset, so integration was tested for the whole time period to check the level of price association between markets. The consumer price index (CPI) was also graphed for the given time period and showed an increasing trend: this behavior was consistent with mango prices.

Table-2 reports the unit root results using ADF tests both with and without a linear trend. The null hypothesis is that the variable observed has a unit root against the alternative that it does not. Both models

indicate that the null of the unit root cannot be rejected for all price series as the absolute values of the ADF statistics are well below the 95% critical value of the test statistics. Thus, we conclude that all the price series are nonstationary.

Table-2: Unit Root Test

Variables	Non-Trended Model	Trended Model
Lahore	-0.27	-2.65
Faisalabad	-1.69	-2.94
Sargodha	-0.88	-1.35
Multan	-0.25	-2.71
Gujranwala	-1.51	-2.50
Karachi	-0.37	-3.05
Hyderabad	-0.22	-3.30
Sukkur	-0.88	-1.41
Peshawar	-0.24	-2.64
Quetta	-0.22	-2.65
Critical Values at 95% Confidence Level	**-2.93**	**-3.50**

In order to test the level or number of unit roots in the data, a unit root test of first difference was conducted that showed the number of unit roots equal to 1 since the data becomes stationary after the first difference as absolute values of the ADF statistics are now greater than the 95% critical value of the test statistics. The results are depicted in Table-3.

Table-3: Unit Root Test of First Difference Series

Variables	Non-Trended Model	Trended Model
Lahore	-5.90	-5.85
Faisalabad	-17.60	-17.60
Sargodha	-5.87	-5.91
Multan	-5.55	-5.50
Gujranwala	-6.02	-6.05
Karachi	-6.25	-6.18
Hyderabad	-18.06	-1784
Sukkar	-5.25	-5.28
Peshawar	-5.88	`-5.83
Quetta	-5.89	-5.84
Critical Values at 95% Confidence Level	**-2.97**	**-3.58**

After testing for a unit root, the next step is to test for cointegration by applying Johansen's procedure to mango prices. The first step is to select the order of the vector autoregressive model. We use the SBC and AIC criteria (Sims 1980), to test the null hypothesis that the order of the VAR is k against the alternative that it is 4 where k=0, 1,…,4 and for all cases, k=1. The values of the results showed the order of VAR equal to 1, as the largest values were found to be at order 1.

The second step in the Johansen procedure is to test the presence and number of cointegration vectors among the series in each model. We tried different models but model 2 (cointegration with restricted intercepts and no trends in the VAR) was found to be the most appropriate. Table-3 presents Johansen's cointegration results. We conducted two tests, eigenvalues and trace tests, to check the number of cointegrating vectors, which were found to be 5 in both the above mentioned tests. These tests confirm that all ten major mango markets in Pakistan are well integrated and price signals are transferred from one to the other to ensure efficiency.

Table-4: Cointegration Results (Overall)

List of the Variables included in the Unrestricted VAR: LK, LL, LM, LF, LG, LH, LSK, LS, LP, LT				
Ho	**H_A**	**Model 2**	**Model 3**	**Model 4**
Cointegrating LR Test Based on Maximal Eigenvalues of the Stochastic Matrix				
r = 0	r = 1	113.99 (64.11)	110.14 (63.32)	121.40 (67.05)
r <= 1	r = 2	86.88 (57.97)	85.87 (57.20)	98.97 (61.27)
r <= 2	r = 3	78.60 (52.06)	59.98(51.15)	60.68 (55.14)
r <= 3	r = 4	58.22 (46.70)	56.36 (45.63)	56.37 (49.32)
r <= 4	r = 5	46.83 (40.53)	42.98 (39.83)	45.3 (43.61)
r <= 5	r = 6	30.58 (34.40)	29.18 (33.64)	35.57 (37.86)
Cointegrating LR Test Based on Trace of the Stochastic Matrix				
r = 0	r = 1	459.37 (245.69)	420.27 (234.98)	483.12 (265.77)
r <= 1	r = 2	345.37 (203.96)	310.12 (194.42)	361.77 (222.62)
r <= 2	r = 3	258.49 (166.12)	224.24 (157.80)	262.74 (182.99)
r <= 3	r = 4	179.89 (132.45)	164.25 (124.62)	202.07 (147.27)
r <= 4	r = 5	121.67 (102.56)	107.89 (95.87)	145.69 (115.85)
r <= 5	r = 6	74.83 (75.98)	64.90 (70.49)	85.31 (87.17)

95% Critical Values in Parentheses.

Note: LK represents the price series in logarithm form for Karachi, whereas LL, LM, LF, LG, LH, LSk, LS, LP and LT represent the price series in Lahore, Multan, Faisalabad, Gujranwala, Hyderabad, Sukkur, Sargodha, Peshawar, and Quetta respectively.
Model 2: Cointegration with restricted intercepts and no trends in the VAR; Model 3: Cointegration with unrestricted intercepts and no trends in the VAR; Model 4: Cointegration with unrestricted intercepts and restricted trends in the VAR.

Even though regional markets are geographically dispersed and spatially segmented, spatial pricing relationships reveal that mango prices are linked, indicating that all mango exchange locations belong to the same economic market. After testing market integration for major mango markets on an overall basis, we tested further the integration between pairs of markets. In pair-wise analysis, the order of VAR was selected as 1.

Maximal eigenvalues and trace tests were used to check the level of market integration between pairs of markets. Again, three models were tried but model 2 was found to be the most appropriate. Results show that both tests complement each other by identifying one cointegrating vector for each pair, stating that all market pairs are integrated with each other. This shows that Karachi, as a base market, transfers price signals to other mango markets. The results of the cointegration analysis are depicted in Table-5.

Table-5: Cointegration Results (Pair Wise)

List of the Variables included in the Unrestricted VAR: LK, LL, LM, LF, LG, LH, LSK, LS, LP, LT					
Markets Pair	**Ho**	**H_A**	**Model 2**	**Model 3**	**Model 4**
	Cointegrating LR Test Based on Maximal Eigenvalues of the Stochastic Matrix				
Karachi-	r = 0	R = 1	29.66 (15.87)	29.65 (14.85)	47.16 (19.22)
Lahore	r <= 1	R = 2	6.45 (9.16)	6.25 (8.07)	10.81 (12.39)
Karachi- Multan	r = 0	R = 1	38.72 (15.87)	38.65 (14.85)	45.36 (19.22)
	r <= 1	R = 2	7.57 (9.16)	7.15 (8.07)	8.54 (12.39)
Karachi-	r = 0	R = 1	34.08 (15.87)	37.79 (14.85)	43.54 (19.22)
Faisalabad	r <= 1	R = 2	6.24 (9.16)	6.79 (8.07)	7.28 (12.39)
Karachi-	r = 0	R = 1	26.85 (15.87)	26.83 (14.85)	42.87 (19.22)
Gujranwala	r <= 1	R = 2	7.22 (9.16)	6.81 (8.07)	10.79 (12.39)
Karachi-	r = 0	R = 1	25.20 (15.87)	25.20 (14.85)	42.33 (19.22)
Sargodha	r <= 1	R = 2	7.02 (9.16)	6.50 (8.07)	12.02 (12.39)
Karachi-	r = 0	R = 1	24.19 (15.87)	24.19 (14.85)	42.92 (19.22)
Sukkur	r <= 1	R = 2	6.92 (9.16)	6.38 (8.07)	10.13 (12.39)
Karachi-	r = 0	R = 1	45.39 (15.87)	45.31 (14.85)	49.26 (19.22)
Hyderabad	r <= 1	R = 2	7.79 (9.16)	7.42 (8.07)	11.54 (12.39)
Karachi-	r = 0	R = 1	31.64 (15.87)	31.60 (14.85)	48.12 (19.22)
Peshawar	r <= 1	R = 2	7.61 (9.16)	7.22 (8.07)	10.26 (12.39)
Karachi-	r = 0	R = 1	30.45 (15.87)	30.42 (14.85)	46.93 (19.22)
Quetta	r <= 1	R = 2	7.61 (9.16)	7.22 (8.07)	9.30 (12.39)
Cointegrating LR Test Based on Trace of the Stochastic Matrix					
Karachi-	r = 0	R = 1	36.12 (20.18)	35.90 (17.86)	76.97 (25.77)
Lahore	r <= 1	R = 2	6.45 (9.16)	6.25 (8.07)	9.81 (12.39)
Karachi- Multan	r = 0	R = 1	46.29 (20.18)	45.81 (17.86)	83.90 (25.77)
	r <= 1	R = 2	7.57 (9.16)	7.15 (8.07)	8.54 (12.39)
Karachi-	r = 0	R = 1	40.32 (20.18)	44.58 (17.86)	80.81 (25.77)
Faisalabad	r <= 1	R = 2	6.24 (9.16)	6.79 (8.07)	7.28 (12.39)
Karachi-	r = 0	R = 1	34.07 (20.18)	33.65 (17.86)	69.66 (25.77)
Gujranwala	r <= 1	R = 2	7.22 (9.16)	6.81 (8.07)	10.79 (12.39)
Karachi-	r = 0	R = 1	32.22 (20.18)	31.70 (17.86)	64.36 (25.77)
Sargodha	r <= 1	R = 2	7.02 (9.16)	6.50 (8.07)	12.02 (12.39)
Karachi-	r = 0	R = 1	31.12 (20.18)	30.58 (17.86)	63.06 (25.77)
Sukkur	r <= 1	R = 2	6.92 (9.16)	6.38 (8.07)	10.13 (12.39)
Karachi-	r = 0	R = 1	53.19 (20.18)	52.74 (17.86)	91.81 (25.77)
Hyderabad	r <= 1	R = 2	7.79 (9.16)	7.42 (8.07)	11.54 (12.39)
Karachi-	r = 0	R = 1	39.26 (20.18)	38.83 (17.86)	78.39 (25.77)
Peshawar	r <= 1	R = 2	7.61 (9.16)	7.22 (8.07)	10.26 (12.39)
Karachi-	r = 0	R = 1	38.07 (20.18)	37.64 (17.86)	76.23 (25.77)
Quetta	r <= 1	R = 2	7.61 (9.16)	7.22 (8.07)	9.30 (12.39)

95% Critical Values in Parentheses.

Even if we demonstrate market integration through cointegration, there could be disequilibrium in the short run, i.e., price adjustment across markets may not happen instantaneously. It may take some time for spatial price adjustments to occur. The error correction model takes into account the adjustment of short-run and long-run disequilibrium in markets and time to remove disequilibria in each period. Table-6 shows that 16-68% of disequilibrium is removed in each period, i.e., one month in the mango markets of Pakistan. This implies that economic agents take between two to six months to adjust to a long-run equilibrium. For example, in Lahore, 66% of the disequilibrium is removed in each period, i.e., one month, while 68% of the disequilibrium is removed in Multan. Other mango markets follow the same pattern of adjustment to shocks except Gujranwala, Peshawar, and Quetta, which show nonsignificant results.

Table-6: Adjustment Vectors from Error Correction Model

Price Relationship: Karachi	Coefficient	T-value	P- value
Lahore	-0.667	-2.71	0.033*
Multan	-0.681	-2.12	0.063*
Faisalabad	-0.396	-2.38	0.007*
Gujranwala	-0.161	-0.728	0.470
Sargodha	-0.428	-2.00	0.051*
Sukkur	-0.43	-2.03	0.047*
Hyderabad	-0.531	-2.40	0.002*
Peshawar	-0.24	-1.11	0.272
Quetta	-0.20	-0.912	0.366

** Significant at 5% Confidence Level.*

Granger causality is also estimated between pairs of domestic mango markets in Pakistan. Granger causality means the direction of price formation between two markets and related spatial arbitrage, i.e., physical movement of the commodity to adjust for these prices differences. Table-7 gives the results of the Granger causality test which show that, in five cases, i.e., Lahore, Faisalabad, Multan, Hyderabad, and Sukkur, there exists bidirectional causality. In these cases, the Karachi Granger causes price formation in the concerned mango markets which in turn provide feedback to the Karachi base market as well. In the case of the other four markets, i.e., Sargodha, Gujranwala, Peshawar, and Quetta, there exist unidirectional relationships between the Karachi base market and concerned mango

markets. This implies that the Karachi market Granger causes price formation in these four markets but they do not provide any feedback to the Karachi base market.

Table-7: Granger Causality from Error Correction Model

Causality	F-Statistics	P-Value	Direction
Karachi → Lahore	3.31	0.028*	Bidirectional
Lahore → Karachi	4.37	0.009*	
Karachi → Multan	4.77	0.006*	Bidirectional
Multan → Karachi	3.12	0.035*	
Karachi → Faisalabad	3.49	0.023*	Bidirectional
Faisalabad → Karachi	4.47	0.008*	
Karachi → Gujranwala	4.00	0.013*	Unidirectional
Gujranwala → Karachi	1.92	0.140	
Karachi → Sargodha	5.91	0.005*	Unidirectional
Sargodha → Karachi	1.70	0.171	
Karachi → Sukkur	3.96	0.014*	Bidirectional
Sukkur → Karachi	2.80	0.050*	
Karachi → Hyderabad	2.48	0.073*	Bidirectional
Hyderabad → Karachi	5.29	0.003*	
Karachi → Peshawar	3.12	0.035*	Unidirectional
Peshawar → Karachi	1.50	0.204	
Karachi → Quetta	3.29	0.029*	Unidirectional
Quetta → Karachi	1.34	0.240	

** Significant at 5% Confidence Level.*

An impulse-response analysis was also carried out to better understand dynamic price interrelationships, how price shocks are transmitted, and how long it takes for shocks to be eliminated in alternate markets. Figure 1 depicts the impulse response in Lahore due to one standard error price shock in the Karachi market. It only takes 1 month for the Lahore market to eliminate the price shock and converge onto long-run equilibrium. These responses are consistent with long-run market integration.

Figure 1: Impulse Response of Lahore to Standard Error Shock in Karachi

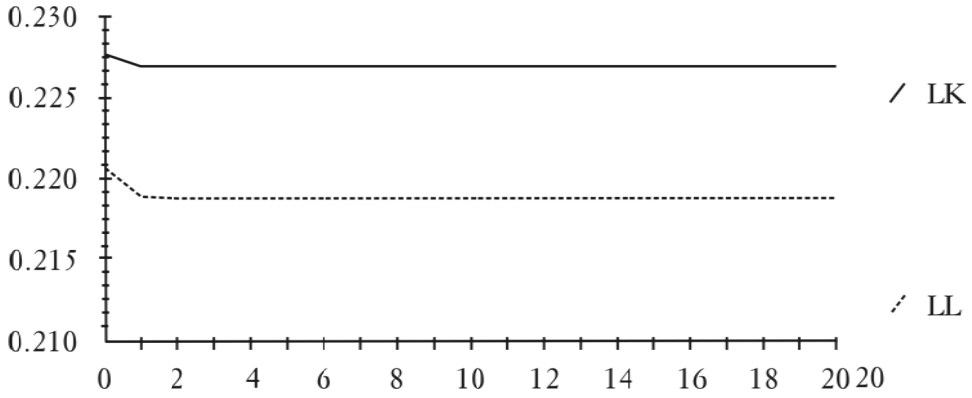


Figure 2 depicts a standard error shock in Karachi and its response in Faisalabad; the graph shows that Faisalabad adjusted to the shock within 1 month.

Figure 2: Impulse Response of Faisalabad to Standard Error Shock in Karachi

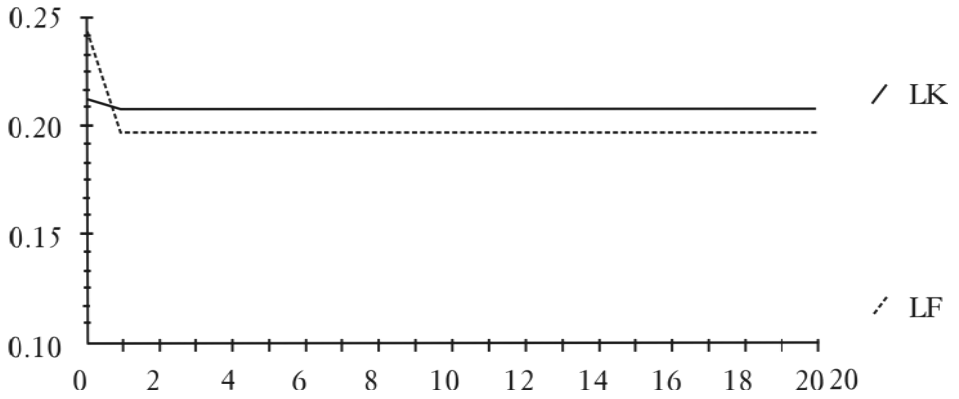


Figure 3 depicts a standard error shock in Karachi and its response in Sargodha, which shows that it took the latter almost 3 months to adjust to the shock. The longer adjustment period relative to Faisalabad and Lahore is justified by the adjustment vector, which in Sargodha's case was found to be nonsignificant.

Figure 3: Impulse Response of Sargodha to Standard Error Shock in Karachi

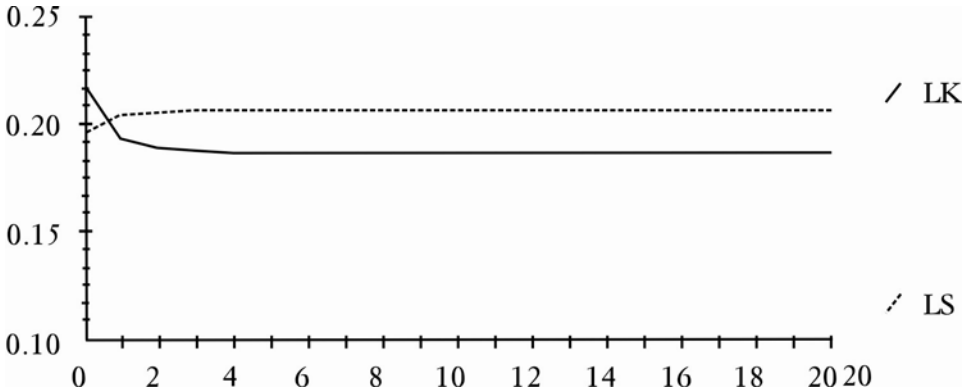
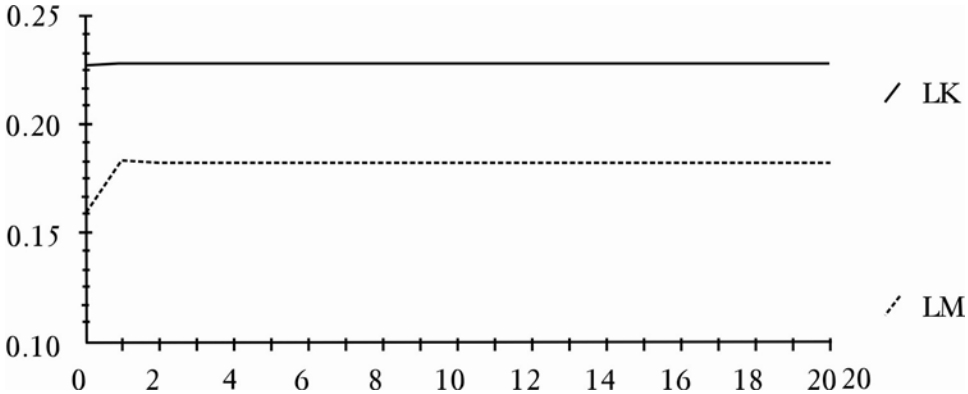


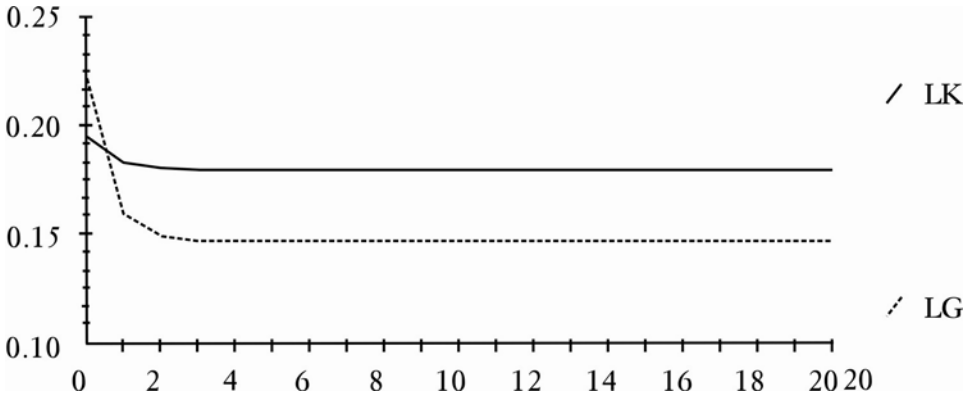
Figure 4 depicts the Multan market, which in response to a shock in Karachi adjusts within less than a month. This shows that there are strong price linkages between the two markets and also justifies the physical arbitrage adjusting for any disequilibrium between the two markets.

Figure 4: Impulse Response of Multan to Standard Error Shock in Karachi



Gujranwala took almost 3 months to adjust from disequilibrium and to move toward a long-run equilibrium (Figure 5).

Figure-5: Impulse Response of Gujranwala to Standard Error shock in Karachi



The other four markets, i.e., Sukkur, Hyderabad, Peshawar, and Quetta behaved in a similar fashion. In response to a standard error shock in the Karachi market, the above mentioned markets adjusted within a month (Figures 6-9).

Figure 6: Impulse Response of Hyderabad to Standard Error Shock in Karachi

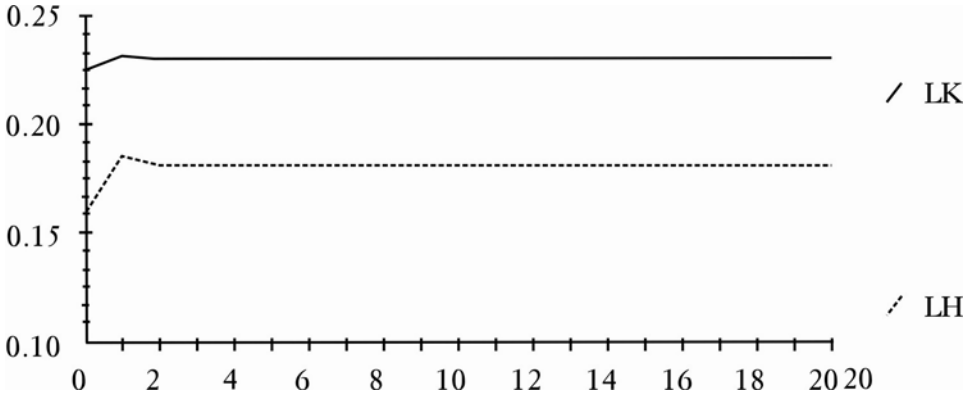


Figure 7: Impulse Response of Sukkur to Standard Error Shock in Karachi

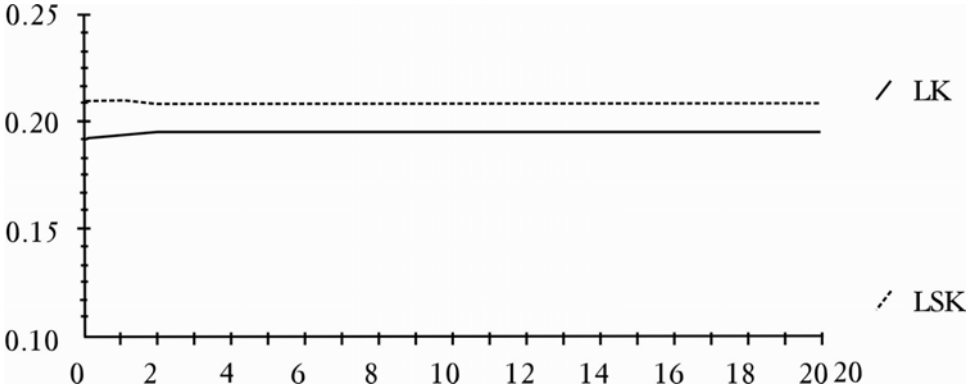


Figure-8: Impulse Response of Peshawar to Standard Error Shock in Karachi

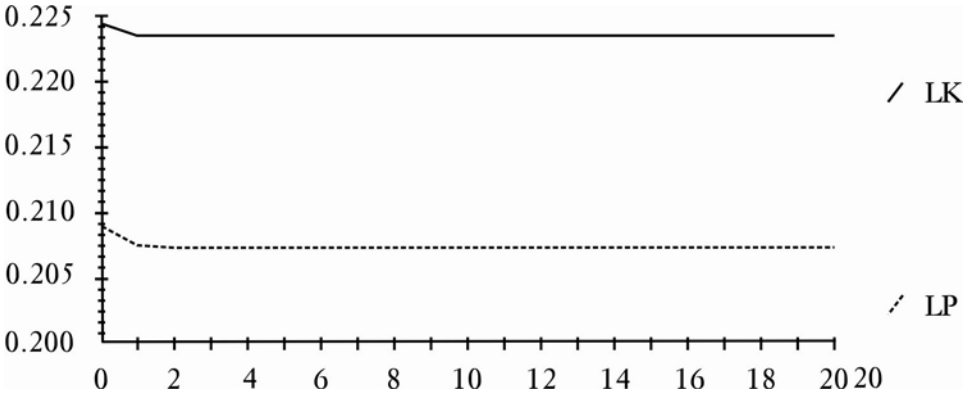
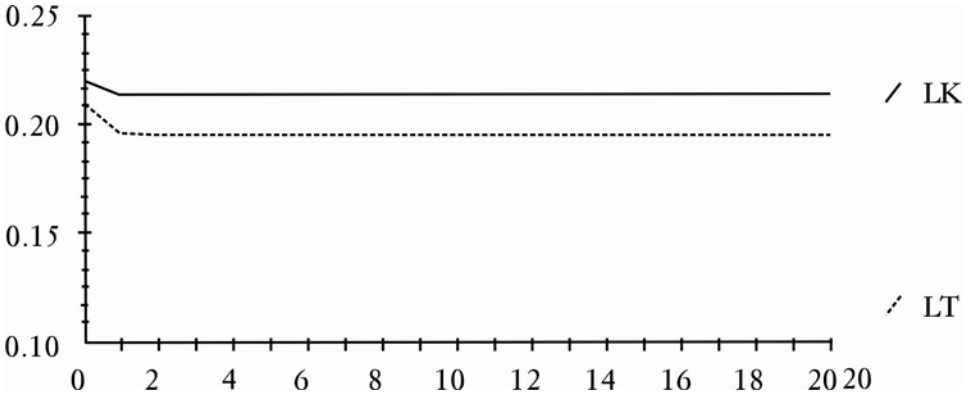


Figure-9: Impulse Response of Quetta market to Standard Error Shock in Karachi



5. Conclusion and Implications

In this paper, we have tried to investigate the level of market integration among major mango markets in Pakistan by using monthly wholesale price data (Rs/100 kg) for the period from 1990 to 2006. Market integration was tested at two levels, i.e., overall and between pairs of mango markets designating Karachi as a base market. In addition to market integration analysis, adjustment vectors were also calculated using an error correction model, which explained the adjustment mechanism in case of a deviation from long-run equilibrium. Granger causality in price formation and related spatial arbitrage was also calculated to verify the direction of pricing relationships between different markets. Finally, an impulse response analysis was also conducted to show the response of different markets to a standard error shock in the Karachi market and markets' subsequent adjustment patterns.

Cointegration analysis was conducted in three steps. First, the ADF test was conducted to check the presence of a unit root; second, the order of VAR was selected using SBC and AIC criteria; and third, cointegration was verified using Johansen's approach. According to our overall market integration analysis, all major mango markets were integrated with each other, which showed the co-movement of prices. This indicates market efficiency. Pair-wise market integration analysis also confirmed that all markets were integrated with the Karachi base market. The adjustment vector implied that about 16-68% of disequilibrium is removed from markets in each period, i.e. one month, which implies that economic agents take almost 2 to 6 months to return to long-run equilibrium.

The adjustment to long-run equilibrium is a good sign with regard to the adjustment response to price differences in major mango markets of Pakistan. Granger causality results showed that, in five cases, i.e., Lahore, Faisalabad, Hyderabad, Multan, and Sukkur, there was bidirectional causality with Karachi as the base market. This implies that the Karachi Granger causes price formation in those markets, which then feed back into the Karachi market. In the case of the other four markets, there was found to be unidirectional causality from Karachi to those markets, indicating that only the Karachi market Granger causes price formation in those markets without any feedback into the base market.

Impulse response analysis was also conducted, which captured the effect of a standard error shock to the Karachi market and its impact on the other markets concerned. Only two markets, i.e., Sargodha and Gujranwala, took 3 months to adjust to equilibrium in response to one standard error

shock to Karachi; all other markets adjusted roughly within one month. Thus, mango markets in Pakistan are well integrated in terms of price responses, suggesting that the government should continue supporting the private sector to operate freely.

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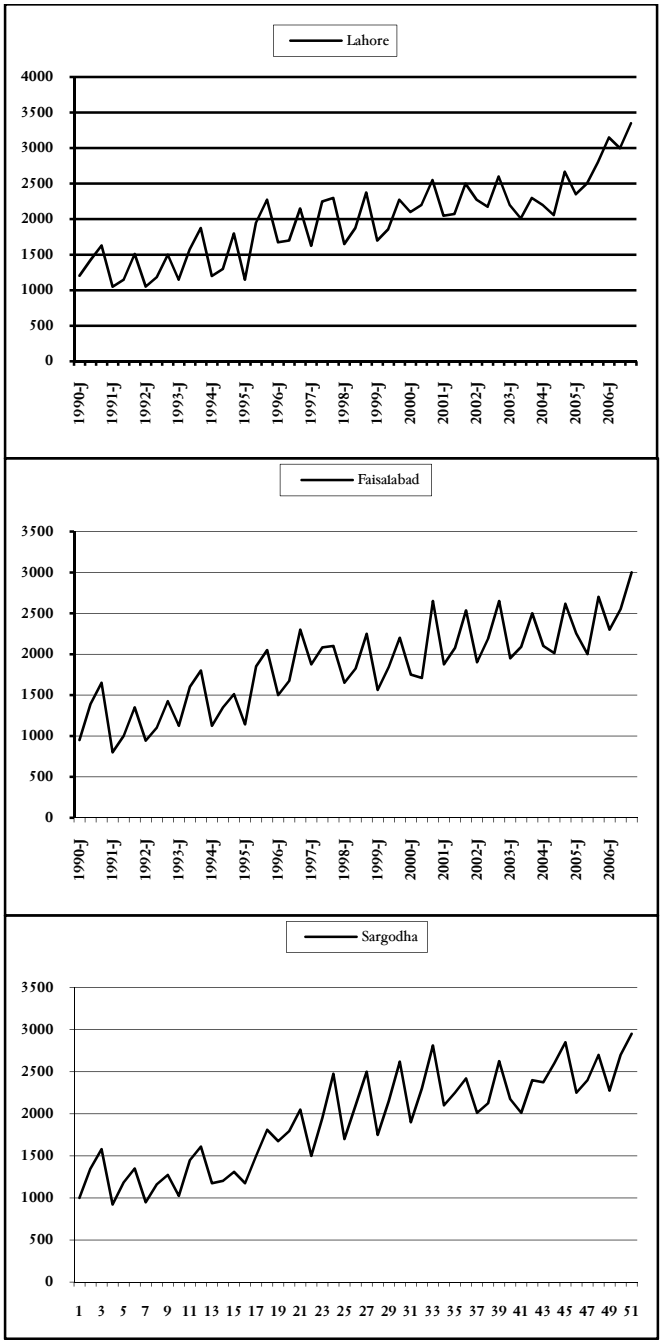
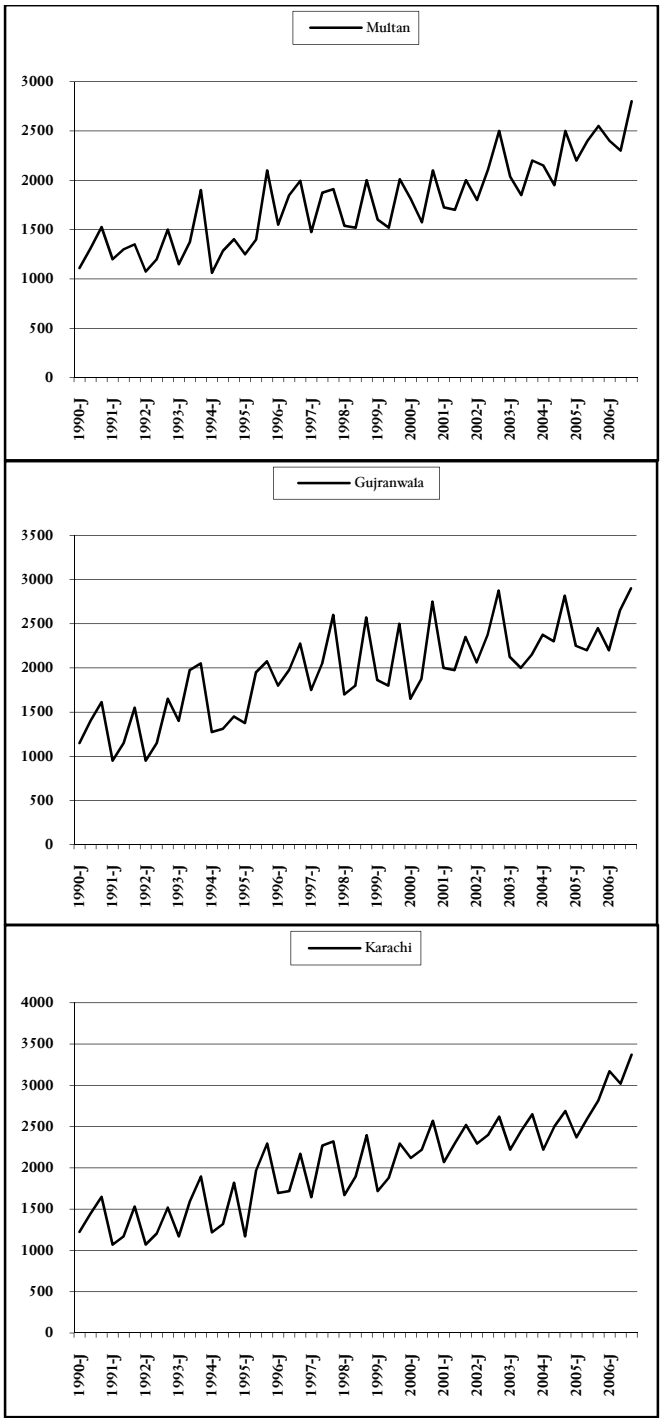
Appendix: Graphical Analysis of Prices in Different Markets and Relation with Consumer Price Index

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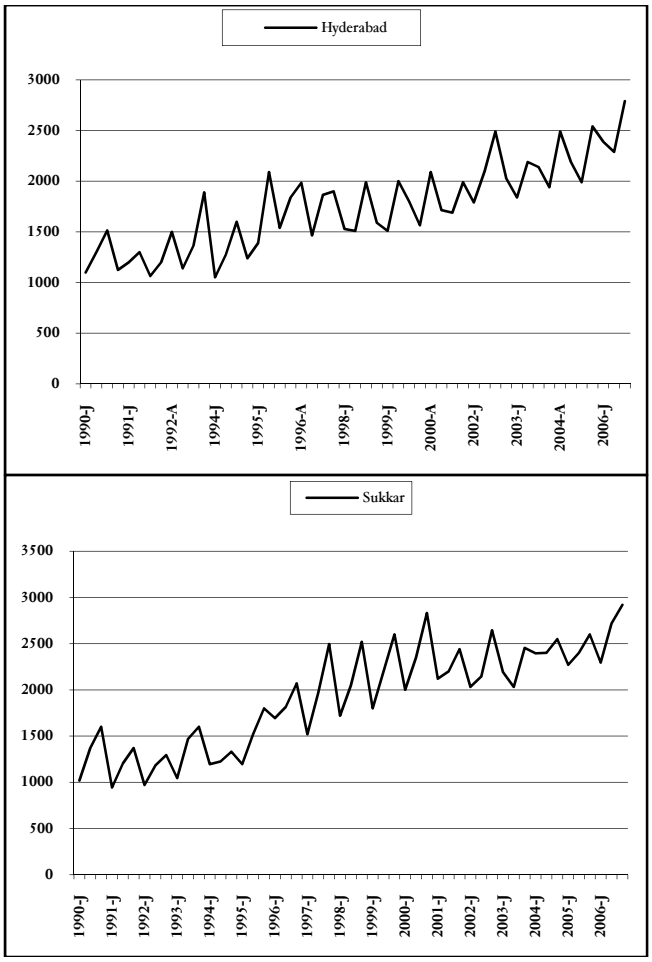
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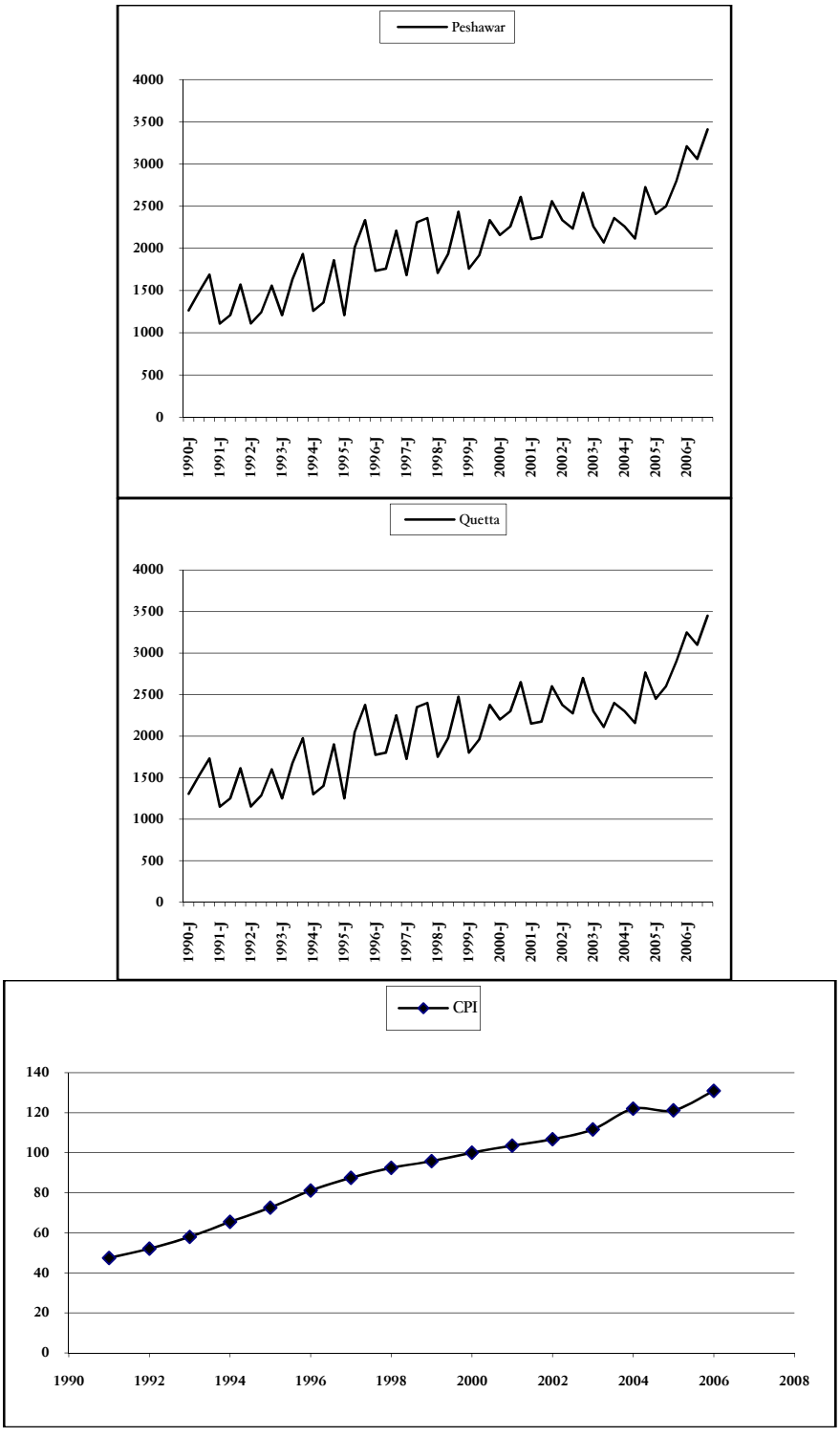
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The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 115-137

An Empirical Investigation of the Causal Relationship among Monetary Variables and Equity Market Returns

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Abstract

This study explores the long-term dynamic relationship between equity prices and monetary variables for the period June 1998 to June 2008. Monetary variables include money supply, treasury bill rates, foreign exchange rates, and the consumer price index. The data have been examined using multivariate cointegration analysis and Granger causality analysis. Johansen and Juselius' multivariate cointegration analysis indicates the presence of a long-term dynamic relationship between the equity market and monetary variables. Unidirectional Granger causality is found between monetary variables and the equity market. In the case of money supply, a positive relationship supports the liquidity hypothesis. Impulse response analysis indicates that the interest rate shock has a negative impact on equity returns in the Pakistani equity market. Exchange rates also have a negative impact on equity returns in the short run. However inflation has little impact on returns in the equity market. Variance decomposition analysis suggests that the interest rate, exchange rate, and money supply shocks are a substantial source of volatility for equity returns. The contribution of a monetary shock to the equity returns ranges from 4% to 16% over different time lags. Similarly, the VECM also confirms the presence of a short-term relationship between monetary variables and equity returns. This state of affairs demands that monetary variables be considered an important factor in determining stock market movements. Policymakers should be more vigilant and careful in designing monetary policies as it has a direct impact on cash inflows into the capital market and on the stability of the capital market.

JEL Classification: E31, G12.

Keywords: Monetary variables, equity, causality, Pakistan.

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1. Introduction

The causal relationship between monetary variables and equity returns has been one of the most debated topics in finance during the last few decades. Equity prices are the most closely observed asset prices in an economy and are considered the most sensitive to economic conditions; high volatility or abnormal movements in equity prices from fundamental values can have adverse implications for the economy. Thus, it becomes imperative to understand the relationship and dynamics of monetary variables and equity market returns.

A number of studies have been conducted to investigate the potential response of equity prices to a change in monetary variables. Jaffe and Mandelker (1976) Fama and Schwert (1977), Nelson (1976) Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burnmeister and Wall (1986), Burmeister and MacElroy (1988), Chang and Pinegar (1990), Defina (1991) Kryzanowski and Zhang (1992), Chen and Jordan (1993), Sauer (1994), and Rahman, Coggin and Lee (1998) explore the relationship between inflation and equity prices. Kryzanowski and Zhang (1992), Sauer (1994), and Mukherjee and Naka (1995) explore the relationship between the foreign exchange rate and equity market returns. Burmeister and MacElroy (1988) study the relationship between short-term interest rates and equity market returns. Studies that explore the relationship between money supply and equity market returns include Friedman and Schwartz (1963), Hamburger and Kochin (1972) and Kraft and Kraft (1977) Beenstock and Chan (1988), Nozar and Taylor (1988), Sauer (1994), and Mukherjee and Naka (1995).

Financial liberalization and globalization provide further impetus for exploration of the subject, especially in the context of emerging markets such as Pakistan. This interrelationship has an economic rationale as discounted cash flow techniques for asset pricing assume that stock prices reflect expectations about futures cash flows. These expectations about cash flows are based on the expected performance of the corporate sector; the performance of the corporate sector is influenced by changing patterns in monetary variables. Therefore, any innovation in monetary variables will affect corporate profits and will ultimately reflect asset prices. If an asset pricing mechanism is efficient and reflects precisely the fundamentals of the corporate sector, then equity prices can serve as a leading indicator of future dimensions of economic activity. The efficient market hypothesis also provides that prices instantly adjust to the arrival of new information and the current prices of securities reflect all the information available about the security. Thus asset prices generally react sensitively to the arrival of new information. This response is neither equal nor homogeneous across all economic changes, and it becomes imperative to investigate the interactions among monetary factors

and equity prices since it will provide the foundations for the formulation of monetary policy in the country.

The influence of monetary variables on equity returns has attracted considerable attention in both developed and developing countries. Many studies have been conducted to find the long-term equilibrium relationship between stock returns and monetary variables for the USA, Japan, and other industrially developed countries. This study focuses on Pakistan as a rapidly growing market in South Asia. The Pakistani equity market has shown tremendous growth in the last few years: The KSE-100 index rose from 1,773 index points in January 2000 to 15,125 in March 2008. This phenomenal growth has also attracted foreign investors and portfolio investment has increased four-fold. In the current economic scenario, it is necessary to explore the relationship between monetary variables and equity returns so that the current dynamics of monetary policy can be examined.

This study examines the long-run dynamic relationship between equity prices and four monetary factors, including the money supply, treasury bill rates, foreign exchange rates, and inflation rates for the period June 1998 to June 2008, using a multivariate cointegration analysis. We also explore the short-term dynamics of equity prices using the VECM. These variables are important as prior studies provide evidence that they have a significant relationship with equity prices in several developed and emerging markets. The study also investigates how the equity market responds to innovations in monetary variables by using an impulse response function and variance decomposition analysis.

The study will help understand the dynamics of equity market activities in an emerging market by identifying monetary variables that affect the equity market, and quantifying the impact of changes in monetary variables on equity market movements. This will enable investors and portfolio managers to make effective investment decisions. It will also facilitate policymakers in the formulation of policies that will not only encourage more capital inflows into the capital market but also provide it with stability.

The paper is arranged in four sections. Section II briefly surveys the empirical literature on the relationship among macroeconomic variables and capital markets. Section III explains the methodology adopted and data employed. The empirical results are discussed in Section IV and Section V concludes the paper.

2. Literature Review

The efficient market hypothesis provides that asset prices respond to the arrival of new information. This response is stronger in the case of certain economic events whereas in other cases it may be weaker. Empirical studies try to identify factors that have a significant influence on equity prices: monetary factors are no exception.

The relationship between equity market returns and exchange rates has attracted the attention of academics and researchers during the last decade due to significant changes in the financial world. This period is known for the emergence of new capital markets, elimination of barriers to capital flows and foreign exchange restrictions, and the adoption of flexible exchange rate arrangements in emerging and transition countries. While these attributes have opened the door for investment opportunities, they have simultaneously increased the volatility of exchange rates and contributed significantly to the overall risk associated with investment decisions and portfolio diversification. Interaction between foreign exchange and equity markets is now more complex and needs greater attention. It is worth mentioning that no consensus exists among academics regarding the presence of a relationship between stock prices and exchange rates, and the direction of the relationship.

Bahmani and Sohrabian (1992) examine the relationship between the exchange rate and equity market returns for the period 1963-1988 by employing cointegration analysis and Granger causality analysis. The study provides evidence of bidirectional causality in the short run. Yu (1997) finds a bidirectional relationship between exchange rates and the equity market in Japan and unidirectional causality flowing from changes in exchange rates to changes in stock prices in Hong Kong. However no causality has been observed in the daily time series of the Singapore market during 1983-1994. Abdalla and Murinde (1997) also examine the relationship between the exchange rate and equity prices in India, Pakistan, Korea and the Philippines for the period 1985-1994 by employing cointegration analysis. The results do not provide evidence of a causal relationship in Korea and Pakistan, but do so of unidirectional causality between the exchange rate and equity prices in India and the Philippines. In India, causality flows from exchange rates to equity prices while in the Philippines, unidirectional causality runs from the equity market to the exchange rate.

Muhammad and Rasheed (2003) explore the relationship between exchange rates and equity prices in Pakistan, India, Sri Lanka, and Bangladesh for the period 1994–2000. The results indicate that no

relationship exists between equity markets and foreign exchange rates in the long or short run in India and Pakistan. However, bidirectional causality is observed between exchange rates and equity markets in Bangladesh and Sri Lanka. Stavárek (2005) examines the presence of causal relationships between equity prices and effective exchange rates in Austria, France, Germany, the UK, Czech Republic, Hungary, Poland, Slovakia, and United States for the period 1970-2003. Results provide evidence of unidirectional causality in the long run as well as short run. Results also indicate that this causal relationship is stronger in developed markets, i.e., Austria, France, Germany, the UK, and US. Moreover, the relationship is found stronger for the period 1993–2003 than 1970–92.

Academics as well as professional observers have explored the relationship between stock prices and various monetary variables that are subjective to monetary policy. One such variable is money supply; initial studies conducted in the 1960s and 1970s generally indicated a strong leading relationship between money supply changes and equity prices. However, subsequent studies have raised questions about the nature of this relationship. They have confirmed the presence of a relationship between money supply and stock prices but the timing of the relationship remains debatable. Rozzef (1974) examines stock market efficiency with respect to money supply by employing regression analysis and trading rule analysis and finds that equity market returns do not lag behind money supply. The study confirms EMH and provides that current equity returns incorporate all information about historical as well as anticipated future changes in money supply. Beenstock and Chan (1988) examine the relationship between equity markets and a set of macroeconomic variables and provide evidence of a positive relationship between equity returns and money supply and inflation.

The relationship between inflation, interest rates, and equity prices is not direct and consistent. Equity prices are based on two factors: (i) discount rate and (ii) expected cash flows. Interest rates and inflation affect both. Different possibilities may exist with respect to expected equity prices. Equity prices may be stable when an increase in interest rates is the result of an increase in the rate of inflation and firms are able to increase prices in line with cost increases. In such a situation, equity prices might not experience a significant change as the negative effect of an increased discount rate is offset by the increase in corporate earnings. However, equity prices may show some negative trend when firms are not able to increase prices proportionately in response to higher costs. However, the impact is most negative when the required rate of return increases and expected cash flows decrease due to inflation. The effect of interest rate changes on stock prices will depend on what caused the change in interest rates and the effect of this event on

expected cash flows on common stock. We cannot be certain whether this change in cash flows will augment or offset the change in interest rates. However, earlier studies like Nelson (1976), Mandelker (1976), Fama and Schwert (1977), and Chen, Roll and Ross (1986) provide evidence of a negative relationship between inflation and equity prices. The latter examines the presence of a long-run relationship between equity prices and seven macroeconomic variables for the US, which include monetary as well as real sector variables. Monetary variables include inflation and interest rates. The results provide evidence, during periods of a high volatility yield curve that unanticipated inflation can explain expected returns.

Hamao (1988) uses the methodology proposed by Chen, Roll and Ross (1986) for the Japanese economy and reveals that variations in expected inflation and unexpected variations in the risk premium and the term structure of interest rates influence equity returns significantly. However, variations in macroeconomic activities are found to be weakly priced in Japan in comparison with variations priced in the US.

Mukherjee and Naka (1995) explore the long-term relation between equity prices in the Japanese stock market and six macroeconomic variables, i.e., money supply, industrial production, exchange rate, inflation, long term government bond rates, and the call money rate by employing monthly data for the period 1/71 to 12/90. They employ a vector error correction model (VECM) to investigate the relationship among these variables and provide evidence of a positive relationship between equity prices and money supply, exchange rate, and industrial production. However, the study is mixed with reference to interest rates and inflation. Zhao (1999) explores the possibility of long-run relationships among industrial production, inflation, and equity prices in the Chinese capital market by employing monthly data for the period 1/1993 to 3/1998. The study reveals a significant negative relationship between equity prices and inflation, and also shows that industrial production significantly influences equity prices in the Chinese economy while the direction of this relationship is negative.

Nishat and Rozina (2001) analyze causal relationships between the Karachi Stock Exchange Index and inflation, industrial production, narrow money, and the money market rate by employing a vector error correction model for the period 1/1973 to12/2004. Results indicate the presence of two cointegrating equations among macroeconomic variables. Industrial production and inflation are identified as the largest determinants of equity prices in the Karachi Stock Exchange. Industrial production has a positive relationship with equity prices whereas inflation is negatively associated with

stock prices. Granger causality is found flowing from macroeconomic variables to stock price, as is industrial production.

Maysami and Koh (2000) examine long-term dynamic interactions between the Strait Times Index (STI) and macroeconomic variables for the period 1988 to 1995 by employing a vector error correction model (VECM). The variables are seasonally adjusted money supply, industrial production index, foreign exchange rate, retail price index (inflation), domestic exports, and interest rates. Results indicate a cointegrating vector among returns on the Strait Times Index (STI) and money supply growth, inflation, term structure of interest rates, and changes in exchange rates. This study investigates the long-term dynamic relationship among S&P 500, Nikkei 225 and STI by using cointegration analysis and finds that the equity markets of the US, Japan and Singapore are co-integrated.

Hussain and Mahmood (2001) investigate the long-run causal relationship between equity prices and macroeconomic variables for the period 7/1959 to 6/1999 by employing a vector error correction framework. Annual data for gross domestic product, consumption and investment is analyzed and it is concluded that a long-run relationship exists between equity prices and macroeconomic variables. Results also reveal the presence of unidirectional causality flowing from macro variables to stock prices. However, the equity market is not found to influence aggregate demand so its movement cannot be termed as a leading indicator of economic activity.

Mishra (2004) investigates the long-run dynamic causal relationship between equity market and macroeconomic variables in India including the foreign exchange rate, interest rate and demand for money for the period 1992 to 2002 by employing the vector auto regression (VAR) technique. This paper applies the Granger causality test to monthly data to examine the direction of the relationship and finds evidence of unidirectional causality flowing from the foreign exchange rate to the interest rate and demand for money. However, no Granger causality is found between equity returns and exchange rate returns.

Akmal (2007) investigates the relationship between equity market prices and inflation in Pakistan for the period 1971-2006 by employing the autoregressive distributed lag (ARDL) approach to observe cointegration among variables and provides evidence that equity returns are hedged against inflation in the long run.

3. Data Description and Methodology

We investigate the long-term dynamic interaction between the Pakistani equity market and monetary variables by employing monthly data for the period 6/1998 to 6/2008. The monetary variables we use include money supply, consumer price index, interest rate and exchange rate. The preference for monthly data is in line with earlier work done by Chan and Faff (1998) to explore the long-run relationship between macroeconomic variables and capital markets.

Stock Market Returns

Stock market returns have been calculated by using following equation

$$R_t = \ln (P_t / P_{t-1})$$

Where R_t is return for month 't'; and P_t and P_{t-1} are closing values of KSE- 100 Index for month 't' and 't-1' respectively.

Money Growth Rate

Narrow money (M_1) is used as a proxy for money supply. The money growth rate has been calculated by using the log difference for narrow money (M_1)

$$\text{Money Growth Rate} = \ln (M_t / M_{t-1})$$

Change in Interest Rate

Treasury bill rates are used as a proxy for the interest rate. Change is measured by log difference to T bill rates.

$$\text{Change in the Interest Rate} = \ln (TB_t / TB_{t-1})$$

Change in Foreign Exchange Rate

The change in the foreign exchange rate is measured by employing the end-of-month US $/Rs exchange rate and the change in value is worked out through log differencing, i.e.,

$$\text{Change in Foreign Exchange Rate} = \ln (FER_t / FER_{t-1})$$

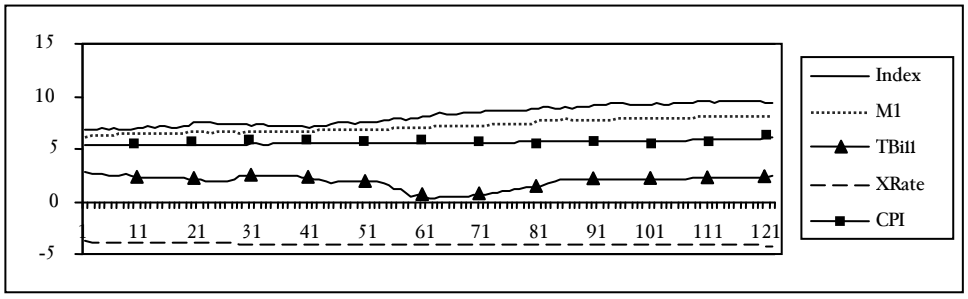
Where FER is the Foreign Exchange Rate US $/Rs

Inflation Rate

The consumer price index (CPI) is used as a proxy for inflation. The CPI is a broad-based measure for calculating the average change in prices of goods and services during a specific period.

$$\text{Inflation Rate} = \ln (CPI_t / CPI_{t-1})$$

Trend in Log of Macroeconomic Series



There are several techniques for testing the long-term dynamic interaction between prices in equity markets and macroeconomic variables. In this study, we emphasize testing the relationship between monetary variables and the Pakistani equity market, via:

- Descriptive statistics
- Correlation matrix
- Cointegration tests
- Granger causality test
- Impulse response analysis
- Variance decomposition analysis

The stationarity of data is tested using unit root tests. The null hypothesis of a unit root is tested using the Augmented Dickey-Fuller (ADF) Test and Phillips-Perron Test. The ADF test examines the presence of a unit root in an autoregressive model. A basic autoregressive model is $Z_t = \alpha Z_{t-1} + u_t$, where Z_t is the variable studied, t is the time period, α is a coefficient, and u_t is the disturbance term. The regression model can be written as $\Delta Z_t = (\alpha - 1)Z_{t-1} + u_t = \delta Z_{t-1} + u_t$, where Δ is the first difference operator. Here, testing for a unit root is equivalent to testing $\delta = 0$.

The ADF tests assume that the error terms are statistically independent and have a constant variance. This assumption may not be true

of all the data used, and so the Phillip-Perron test is used to relax the above assumptions and permit the error disturbances to be heterogeneously distributed. This can be represented mathematically by

$$Z_t = \alpha_o + \alpha_1 Z_{t-1} + \alpha_t \{t - T/2\} + u_t$$

Test statistics for the regression coefficients under the null hypothesis that the data are generated by $Z_t = Z_{t-1} + u_t$, where $E(u_t) = 0$.

If a time series is nonstationary but becomes stationary after differencing, then it is said to be integrated of the order one i.e. I (1). If two series are integrated of order one, there may exist a linear combination that is stationary without differencing. If such a linear combination exists then such streams of variables are called cointegrated.

Cointegration tests are divided into two broader categories: (i) residual-based tests, and (ii) maximum likelihood-based tests. Residual-based tests include the Engle-Granger (1987) test while maximum likelihood-based tests include the Johansen (1988, 1991) and Johansen-Juselius (1990) tests. During this study, we apply the Johansen and Juselius test to determine the presence of cointegrating vectors in a set of nonstationary time series data. The null hypothesis is that there is no cointegration among the series. The vector autoregressive (VAR) approach is employed to test multivariate cointegration. This assumes that all the variables in the model are endogenous. The Johansen and Juselius procedure is employed to test for a long-run relationship between the variables. Johansen and Juselius suggest two likelihood ratio tests for the determination of the number of cointegrated vectors. The maximal eigenvalue test evaluates the null hypothesis that there are at most r cointegrating vectors against the alternative of r + 1 cointegrating vectors. The maximum eigenvalue statistic is given by,

$$\lambda_{max} = - T \ln (1 - \lambda_{r+1})$$

Where λ r+1,...,λn are the n-r smallest squared canonical correlations and T = the number of observations.

A trace statistic tests the null hypothesis of r cointegrating vectors against the alternative of r or more cointegrating vectors. This statistic is given by

$$\lambda_{trace} = -T \Sigma \ln (1 - \lambda_i)$$

In order to apply the Johansen procedure, lag length is selected on the basis of the Akaike Information Criterion (AIC).

If cointegration is present in the long run, then the system of equations is restructured by inserting an error correction term to capture the short-run deviation of variables from their relevant equilibrium values. This is necessary as the impact of financial development is generally more apparent in the short run and disappears in the long run as the economy expands and matures. According to Granger (1988), the presence of cointegrating vectors indicates that Granger causality must exist in at least one direction. A variable Granger causes the other variable if it helps forecast its future values. In cointegrated series, variables may share common stochastic trends so that dependent variables in the VECM must be Granger-caused by the lagged values of the error correction terms. This is possible because error correction terms are functions of the lagged values of the level variables. Thus, evidence of cointegration between variables itself provides the basis for the construction of an error correction model (ECM). The ECM permits the introduction of past disequilibrium as explanatory variables in the dynamic behavior of existing variables and thus facilitates in capturing both the short-run dynamics and long-run relationships between variables. The chronological Granger causality between the variables can be explored by applying a joint F-test to the coefficients of each explanatory variable in the VECM. The variance decomposition of equity returns is based on an analysis of responses of the variables to shocks. When there is a shock through the error term, we study the influence of this shock on other variables of the system and thus obtain information on the time horizon and percentage of the error variance. The F test is in fact a within-sample causality test and does not allow us to gauge the relative strength of the causality among variables beyond the sample period.

In order to examine out-of-sample causality, we use variance decomposition analysis which partitions the variance of the forecast error of a certain variable into proportions attributable to shocks to each variable in the system. Variance decomposition analysis presents a factual breakup of the change in the value of the variable in a particular period resulting from changes in the same variable in addition to other variables in preceding periods. The impulse response analysis investigates the influence of a random shock to a variable on other variables of interest. Impulse responses of returns in various markets to a shock in oil innovations are also examined. Impulse responses show the effect of shocks separately for different days whereas variance decomposition analysis exhibits the cumulative effect of shocks.

4. Empirical Results

Table-1 exhibits descriptive statistics. The average monthly returns in percentage terms in the Karachi Stock Exchange are 2.2% which is equivalent to an annualized return of 40.4%. This is one of the highest returns offered by emerging equity markets. The maximum return in the Karachi stock market in 1 month is 24.11% whereas the maximum loss in one month is 27.8%. The average money supply growth rate is 1.67% per month which is significantly high. Average inflation per month is 0.56% whereas T bill rates appear to change at a rate of 0.25% per month. The average decrease in the value of Pakistani currency is 0.35%. Percentage changes in exchange rates range from a minimum of -7.62% to a maximum value of 3.03%. However, significant volatility is observed in equity returns and monetary variables, especially equity returns and interest rates.

Table-1: Descriptive Statistics

	Returns	Money growth rate	Change in T bill rate	Change in X rate	Inflation
Mean	0.0220	0.0167	-0.0025	-0.0035	0.0056
Median	0.0219	0.0091	0.0000	-0.0006	0.0047
Std Dev	0.0912	0.0422	0.0985	0.0121	0.0070
Skewness	-0.3055	0.0422	0.0121	0.0985	0.0070
Minimum	-0.2780	-0.0646	-0.4242	-0.0762	-0.0088
Maximum	0.2411	0.3481	0.3200	0.0307	0.0303

Weak correlation is observed between the equity return and monetary variables. The money growth rate is positively correlated with returns that are in line with results drawn by Maysami and Koh (2000). A possible reason for this is that an increase in money supply leads to an increase in liquidity that ultimately results in the upward movement of nominal equity prices. Interest rates are negatively correlated with equity returns, which is in line with economic rationale but this relationship is weak. An increase in interest rates leads to an increase in discount rates in the economy. Since the price of equity shares is theoretically equal to the present value of cash flows, higher discount rates lead to a reduction in prices. Similarly, the interest rate parity theory is also confirmed by our results as the interest rate is negatively correlated with exchange rates. However, the results indicate a weak correlation among variables as evident from Table-2.

Table-2: Correlation Matrix

	Returns	Money growth rate	Change in T bill rate	Change in X rate	Inflation
Returns	1.0000				
Money growth rate	0.0241	1.0000			
Change in T bill rate	-0.1429	-0.0198	1.0000		
Change in X rate	0.1219	0.1455	-0.1974	1.0000	
Inflation	-0.1698	-0.0145	0.2557	-0.2029	1.0000

Correlation analysis is a relatively weaker technique. The causal nexus among monetary variables has been investigated by employing multivariate cointegration analysis. Cointegration analysis tells us about the long-term relationship among equity returns and set of monetary variables. Cointegration tests involve two steps. In the first step, each time series is scrutinized to determine its order of integration. To meet this requirement, unit root tests designed by Dickey and Fuller (1979) and Phillips and Perron (1988) have been employed. In the second step, the time series is analyzed for cointegration by using the likelihood ratio test, which includes (i) trace statistics and (ii) maximum Eigen value statistics.

A financial time series is said to be integrated to order one i.e, I (1), if it becomes stationary after differencing once. If two series are integrated to order one and a linear combination of these is stationary without requiring differencing, then the data streams are cointegrated.

Our first step is to test the stationarity of the index series. For this purpose, the ADF test for unit roots has been used at level and first difference. Table-3 exhibits the results of the Dickey-Fuller (ADF test), which clearly show that the time series is not stationary at level but that the first differences of the logarithmic transformations of the series are stationary. Thus, the series is integrated to the order of one I (1).

Table-3: Unit Root Analysis

	ADF- Level	ADF- Ist Diff	PP- Level	PP- Ist Diff
Ln Index	-2.1686	-12.015	-2.0872	-12.2821
Ln Money supply	-1.8832	-10.245	-1.9545	-10.2284
Ln T bill rate	-1.6981	-3.6063	-1.3595	-7.8162
Ln X rate	-2.3659	-6.6074	-3.1003	-6.4168
Ln CPI	2.9023	-8.6160	2.6215	-8.6190
1% Critic. Value	-4.0363	-4.0363	-4.0363	-4.0363
5% Critic.Value	-3.4477	-3.4477	-3.4477	-3.4477
10% Crit.l Value	-3.1489	-3.1489	-3.1489	-3.1489

The Dickey-Fuller test requires that the error terms be statistically independent and data homoskedastic. However, in certain cases these assumptions may not be true for some data, and so we use another important technique, the Phillips-Perron test, to test the stationarity of the time series. Table-3 also displays the results of the Phillips-Perron test, which confirms the results of the ADF test. Thus, we can conclude that the series is I (1).

Having met these prerequisites, we can now perform cointegration analysis. The maximum likelihood-based Johansen (1988, 1991) test and Johansen-Juselius (1990) procedure is used to determine the presence of cointegrating equations in a set of nonstationary time series. A trace statistic has been used to test the null hypothesis of r cointegrating vectors against the alternative of r or more cointegrating vectors. Table-4 exhibits the results of the multivariate cointegration test for the entire sample period.

Table-4: Multivariate Cointegration Analysis Trace Statistic

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Critical Value0.05	Prob.
None *	0.21	71.27	69.82	0.04
At most 1	0.17	44.20	47.86	0.11
At most 2	0.09	22.60	29.80	0.27
At most 3	0.07	12.17	15.49	0.15
At most 4	0.03	3.52	3.84	0.06

The trace test indicates one cointegrating equation at the $\alpha = 0.05$.

Table-5 fails to reject the null hypothesis of no cointegration between the equity indices and monetary variables for the period 6/1998 to 6/2008 in the Pakistani equity market. The trace test indicates the presence of one cointegrating equation at the 0.05 level. Therefore, the result provides evidence of a long-term relationship between monetary variables and equity prices. However, it must be noted here that the Johansen cointegration tests do not account for structural breaks in the data.

According to the representation theorem, if two variables are cointegrated then Granger-causality must exist in at least one direction. The results of Granger causality are reported in Table-5. Rejection of the null hypothesis at 5% indicates that there exists unidirectional Granger causality between the money growth rate and equity returns at the 5% level. Similarly, unidirectional Granger causality also exists between the interest rate, inflation, exchange rate and equity returns. This indicates that monetary variables are Granger-causing equity returns. Treasury bill rates are also Granger-causing exchange rates. These results are consistent with Nishat (2001) who indicates that inflation and equity returns are negatively related to each other.

Table-5: Granger Causality Test

Null Hypothesis	Obs	F-Statistic	Probability
M1 Growth does not Granger Cause Returns	117	2.865	0.040
Returns does not Granger Cause M1 Growth		0.566	0.639
T bill rate does not Granger Cause Returns	117	3.511	0.018
Returns does not Granger Cause T bill rate		0.906	0.441
Change in X rate does not Granger Cause Returns	117	6.191	0.001
Returns does not Granger Cause Change in X rate		0.099	0.960
CPI does not Granger Cause Returns	117	2.980	0.035
Returns does not Granger Cause CPI		0.395	0.757
T bill rate does not Granger Cause M1 Growth	117	3.546	0.017
M1 Growth does not Granger Cause T bill rate		1.938	0.128
Change in X rate does not Granger Cause M1	117	0.481	0.696
M1 does not Granger Cause Change in X rate		0.146	0.932
CPI does not Granger Cause M1 Growth	117	2.078	0.107
M1 Growth does not Granger Cause CPI		0.376	0.770
Change in X rate does not Granger Cause T bill rate	117	1.113	0.347
T bill rate does not Granger Cause Change in X rate		3.087	0.030
CPI does not Granger Cause T bill rate	117	0.924	0.432
T bill rate does not Granger Cause CPI		1.180	0.321
CPI does not Granger Cause Change in X rate	117	1.203	0.312
Change in X rate does not Granger Cause CPI		1.668	0.178

Since a long-run association has been observed between equity prices and monetary variables, we can explore the possibility of a short-run relationship by using an ECM framework. The results of the ECM report indicate that the error term is significant at $\alpha = 0.05$ and 33% of disequilibrium is adjusted within a lag of one period.

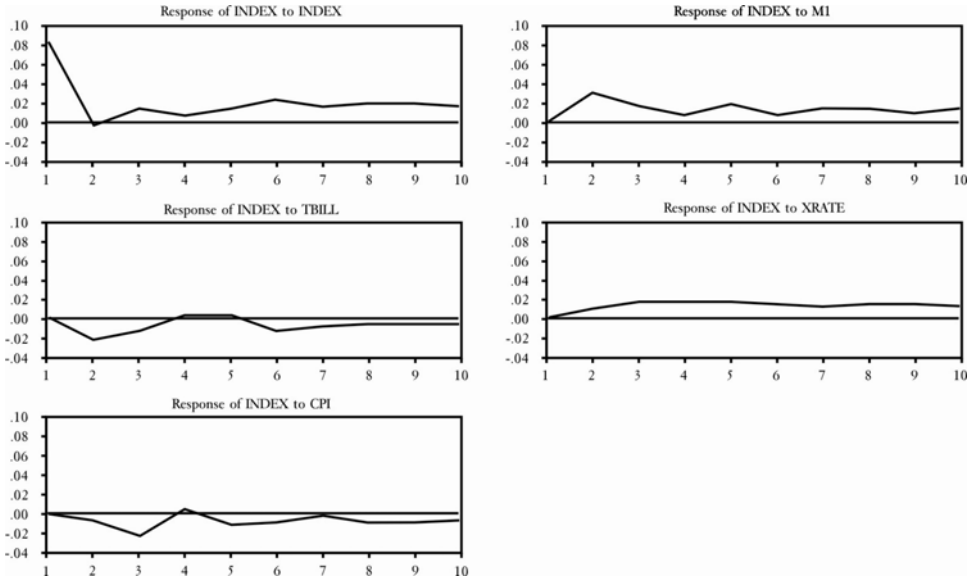
ecm = ln index -1.3963*M1 + 0.19526*LnTBILL -1.3288*LnXRATE - 0.70738*LnCPI

It is worth mentioning that the coefficients of the money supply, T-bill rate and exchange rate are significant at $\alpha = 0.05$.

The responses of equity returns have also been examined by using impulse response analysis (IRF) in the VAR system and results are shown in Figure-1. Impulse response functions capture the effect innovations in money growth rate, T-bill rates, exchange rate and inflation on equity returns in the Karachi stock market. Figure-1 shows the impulse response of equity returns from a one standard deviation shock to monetary variables. The statistical significance of the impulse response function has been examined at 95% confidence bounds. These figures confirm that a one standard deviation change in money supply leads to an increase in equity prices due to an increase in liquidity; this result is consistent with Maysami and Koh (2000). Similarly, a one standard deviation change in the T-bill rate leads to a reduction in the price of equity due to increased discount rates. No statistically significant impact has been observed with reference to a variation in exchange rates. This is reasonable because Pakistan has had a managed floating rate system and, during the last five years, exchange rates have been managed within a small range by the State Bank of Pakistan through open market operations. These results are in conformity with earlier work.

Fig.-1: Impulse Response Analysis

Response to Cholesky One S.D. Innovations



Impulse response functions display the response of an endogenous variable over time to a given innovation. On the other hand, variance decomposition analysis expresses the contributions of each source of innovation to the forecast error variance for each variable. Thus, we have

conducted a variance decomposition analysis to measure the degree to which shocks to the equity market are explained by money supply, T-bill rates, exchange rates and inflation. This also supports the pattern of linkages between monetary variables and equity markets and enhances our insights into the reaction of markets to system-wide shocks. It also helps identify the pattern of response transmission over time. Table 6 exhibits the decomposition of forecast error variance for the equity market that is explained by monetary variables.

Table-6: Variance Decomposition Analysis

Period	SE	Returns	M1 Growth	Change in T bills rate	Change in X rate	Change in CPI
1	0.0838	100.0000	0.0000	0.0000	0.0000	0.0000
2	0.0927	81.8340	10.6955	6.2005	0.9531	0.3169
3	0.1005	71.9706	12.1346	7.2983	3.7298	4.8667
4	0.1026	69.7728	12.2185	7.0533	6.0189	4.9365
5	0.1078	64.9402	14.6710	6.4407	8.2748	5.6734
6	0.1127	63.7044	13.8983	7.2692	9.4382	5.6900
7	0.1159	62.3909	14.9289	7.3497	9.9227	5.4079
8	0.1195	61.0919	15.4836	7.1243	10.7386	5.5616
9	0.1228	60.2977	15.4341	6.9971	11.6140	5.6571
10	0.1259	59.0425	16.1902	6.9894	12.2330	5.5450

Variance decomposition analysis suggests that the money growth rate, change in T-bill rate and change in exchange rate are considerable sources of volatility in equity returns. The contribution of an exchange rate shock to equity returns ranges from 6.2 to 7.3%. Similarly, the contribution of changes in T-bill rates and inflation to the equity market is also significantly high, ranging from 4 to 6%. The money growth rate also contributed to equity market volatility during 1998-2008.

5. Conclusion

This paper examines the lead lag relationship among stock prices and four important monetary variables which include money supply, T-bill rates, exchange rates, and inflation for the period 6/1998 to 6/2008 by using multivariate cointegration analysis and the Granger causality test. The results provide evidence on information transmission in equity markets and explain

the impact of changes in monetary variables on the stock market. Multivariate regression analysis provides evidence of one cointegration vector, which is an indicator of a long-term relationship among the variables concerned.

The Granger causality test indicates that the money growth rate Granger-causes returns. This appears logical as an increase in money supply leads to increased inflation, which translates into discount rates and ultimately results in reduction of prices. Similarly, the T-bill rate and inflation Granger-cause equity returns. These results are consistent with Nishat (2001) who indicates that inflation and equity returns are negatively related. The impulse response analysis shows that a one standard deviation change in money supply leads to an increase in equity prices due to an increase in liquidity; this is consistent with Maysami and Koh (2000).

Similarly, a one standard deviation change in the T-bill rate leads to a reduction in the prices of equity due to increased discount rates. A statistically significant impact has been observed with reference to variations in exchange rates. In order to take an overall view of the volatility of returns, we performed a variance decomposition analysis which revealed that the money growth rate, change in T-bill rate and change in exchange rate are considerable sources of volatility in equity returns. The contribution of an exchange rate shock to equity returns ranges from 3 to 14%. Similarly, the contribution of changes in T-bill rates to the equity market is also significant. The money growth rate also contributed to equity market volatility during 1998-2008. Similarly, the significant impact of inflation on equity prices is captured in our findings.

We can conclude that monetary variables have a long-run as well as short-run relationship with equity returns. The identification of the impact of monetary variables on stock market behavior facilitates investors in making effective investment decisions as by estimating expected trends in exchange rates, interest rate, and money supply, investors can estimate the future direction of equity prices and thus allocate their resources more efficiently. Architects of monetary policy should keep in mind the impact of changes in interest rates on the capital market in the form of a reduction of prices. The central bank should consider the impact of money supply on capital markets. Under the efficient market hypothesis, capital markets respond to the arrival of new information, implying that macroeconomic policies should be designed to provide stability to the capital market.

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The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 139-171

The Impact of Corporate Governance on the Cost of Equity: Empirical Evidence from Pakistani Listed Companies

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Abstract

This study examines the impact of the quality of corporate governance, as measured by a specially constructed corporate governance index, on the expected cost of equity calculated using the capital asset pricing model (CAPM) approach. A total of 114 listed companies were investigated to analyze the relationship between the two variables for the period 2003 to 2007. The quality of corporate governance was measured by assigning weights to a set of related variables, although these variables were also considered individually. We used descriptive statistics, a correlation matrix, a simple ordinary least squares (OLS) approach, and fixed effect model to test the panel data collected. We found a negative relationship between managerial ownership and board size with the cost of equity, and a positive relationship between board independence, audit committee independence, and corporate governance with the cost of equity. These results could be due to the transition phase through which Pakistani companies are passing after the promulgation of the Code of Corporate Governance in 2002.

JEL Classification: G30, G34.

Keywords: Corporate governance, cost of equity, Pakistan.

1. Introduction

While public attention was drawn to the importance of corporate governance only after major scandals such as Enron and WorldCom were unearthed, it would be wrong to assume that the concept of corporate governance is new. The need for good corporate governance arose at about the same time that the ownership and management of corporate entities were separated, and the application of agency theories set in. Like the proverbial child who must cry for his mother's attention, companies have always needed good corporate governance but only when small investors

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started to cry out (after losing heavily in corporate scandals) did regulators and professional bodies start paying formal attention to developing and documenting more elaborate mechanisms of corporate governance.

The prime objective of corporate governance is to ensure protection of the interests of all stakeholders of a company. Responsible decision-making at the board level communicated transparently on a timely basis to all those concerned gives equity providers greater confidence in a company. In turn, this reduces the perception of risk and ultimately curtails the cost of equity.

In developed markets, this has been proven by a number of studies conducted by regulators, governments, and independent institutions. The theme of current worldwide corporate governance has been influenced by reports issued by the Cadbury Committee (1992), Greenbury Committee (1995), Hampel Committee (1998), and Turnbull Committee (2003), and Higgs (2003). Several corporate governance codes and recommendations have emerged on the basis of these reports and are practiced in different parts of the world.

Corporate governance is even more important for emerging and less developed markets—Pakistan is no exception. The first Code of Corporate Governance in Pakistan was promulgated in March 2002 by the Securities and Exchange Commission of Pakistan (SECP), the apex regulator of the country's corporate sector.

The relationship between corporate governance and the cost of equity has been extensively examined in developed and emerging markets. However, no comprehensive or significant work has been done in this regard in Pakistan. This study is an effort to bridge the gap, providing an insight into the relationship between different but pertinent variables as well as facilitating financial managers and policymakers in making judicious and rational financial decisions.

With reference to Pakistan, the study is important because the Pakistani corporate sector has traditionally been dominated by family-owned businesses and nonprofessional boards of directors elected on the basis of their links with concentrated ownership. In this situation, decisions are perceived to serve the interest of only one party, making it difficult to gain and sustain the trust of other stakeholders. With the company permanently controlled by one family with limited access to funds and a restricted professional base, the decision-making process at the board level is apt to stagnate. Generally, investing does not support family-controlled companies

as the family is (often rightly) deemed to make all decisions to suit its own interests. Many such families often expropriate the dues of other stakeholders. This means that, for a family-controlled company to become a truly public company, a very high level of agency costs are involved, pushing up the company's weighted average cost of capital (WACC). In turn, a higher WACC deters the investing public. Thus, many family-controlled companies find themselves in a Catch 22 situation: low availability of funds due to higher agency costs, and higher agency costs due to low availability of funds.

A high WACC has other damaging consequences. Since it is normally used as the opportunity cost for evaluating any further investment opportunities, very few new investments can measure up to the high level of return sought. This curtails both growth and diversification possibilities. The cost of equity is one of the foremost constituents of WACC—in unleveraged companies, it is the only component of WACC. The high cost of equity is a severe deterrent for managers and a serious impediment to attempts to raise additional funds.

The other side of the coin is that if companies succeed in gaining and sustaining the confidence of the investing public, their cost of equity will shrink. This brings down the threshold of internal rate of return (IRR) sought from new projects—opening doors for expansion and diversification—with positive consequences for the company, its stakeholders, and the country.

The purpose of this study is to highlight the relationship between corporate governance practices (which help a company gain and sustain the confidence of the investing public) and the cost of equity (which helps a company grow and diversify). Our findings may provide direction to policymakers to augment or modify the extent and depth of corporate governance practices, helping the growth of a proper corporate culture in the country.

The study is organized as follows. The next section lists the work already carried out by other researchers in the form of a literature review. The third section elucidates the study's data and methodology. The fourth section presents and discusses the study's results. The fifth section presents conclusions drawn from the study.

2. Literature Review

This section is organized into three parts: the first summarizes the literature on corporate governance, the second section lists studies relevant to

the cost of equity capital, and the third section includes literature that studies the relationship between corporate governance and the cost of equity capital.

2.1. Corporate Governance

Managers are considered responsible for making decisions to protect the interests of society as well as the interests of their organization. This behavior is necessary for companies themselves, although some scholars argue that considerations of social responsibility should not enter the decision-making process. However, many institutional investors pay attention to corporate social behavior and thus influence the market for a company's stock.

Corporate governance has been increasingly emphasized both in practice and academic research (e.g., Blue Ribbon Committee Report 1999, Ramsay Report 2001, Sarbanes-Oxley 2002, Bebchuk and Cohen 2009). This emphasis is due in part to the prevalence of highly publicized and egregious financial reporting frauds such as Enron, WorldCom, Aldelphia, and Parmalat; an unprecedented number of earnings restatements (Wu, et al 2002; Palmrose and Scholz 2002; Larcker, et al 2004); and claims of blatant earnings manipulation by corporate management (Krugman 2002). Further, academic research has found an association between weaknesses in governance and poor financial reporting quality, earnings manipulation, financial statement fraud, and weaker internal controls (Dechow, et al 1996; Beasley 1996). Given these developments, there has been an emphasis on the need to improve corporate governance over the financial reporting process (Levitt 1998, 1999, 2000), such as enacting reforms to improve the effectiveness of the audit committee (Blue Ribbon Committee 1999; Sarbanes-Oxley Act 2002) and to make the board of directors and management more accountable for ensuring the integrity of financial reports (SEC 2002, The Business Roundtable 2002) as well as a rapidly expanding body of research on corporate governance.

Corporate governance practices can be determined by the scope and nature of associated agency problems (agency characteristics) of firms, i.e., their need to attract external investment or external investors' difficulties in monitoring the firms. As La Porta, et al (1998) argue, good corporate governance is needed for better access to external financing at a lower cost. This indicates that firms in need of a good deal of external financing, such as rapidly growing firms, have an incentive to improve their corporate governance. In addition, as Himmelberg, Hubbard, and Palia (1999) argue, firms facing large information asymmetries because of other characteristics of their firms may signal to the market their intent to better protect

investors by adopting good corporate governance policies. This might be the case for large firms, young firms, or firms with relatively large intangible assets.

2.2. Measuring Corporate Governance Practices

In the literature, different authors have used different criteria to measure the efficacy of corporate governance practices. Some have used score boards, others have directly identified variables for corporate governance and independently investigated relationships they wanted to capture. Some have used both methods in their research. The corporate governance rankings by the investment bank Brunswick Warburg that Black (2000) uses are based on eight corporate governance elements with different weights: (i) disclosure and transparency, (ii) dilution through share issuance, (iii) asset stripping and transfer pricing, (iv) dilution through a merger or restructuring, (v) bankruptcy, (vi) limits on foreign ownership, (vii) management's attitude toward shareholders, and (viii) registrar risk.

Black, Jang, and Kim (2003) choose 42 items from 123 survey questions, excluding those asking management's views rather than facts, those irrelevant to corporate governance, those that are ambiguous as to whether they represent good or bad corporate governance, and those to which the answers vary little from firm to firm. They then classify the 42 items into four categories, each of which has an equal weight of 0.25: (i) shareholders' rights, (ii) the board of directors in general, (iii) outside directors, and (iv) disclosure and transparency.

The survey that Klapper and Love (2002) use comprises a total of 57 questions with "yes" or "no" answers. They are classified into the following seven categories: (i) discipline, (ii) transparency, (iii) independence, (iv) accountability, (v) responsibility, (vi) fairness, and (vii) social awareness. Each category has a weight of 0.15 except for the last one, which has a weight of 0.10.

Chhaochharia, et al (2005) measure corporate governance using four different variables: (i) insiders' engagement in fraudulent activity, (ii) the existence of well-functioning internal control mechanisms, (iii) insiders' engagement in related party transactions, and (iv) the compliance of the board of directors with the new independence requirements.

Chen (2004) includes 57 criteria that are grouped into seven major categories: (i) transparency, (ii) management discipline, (iii) independence, (iv) accountability, (v) responsibility, (vi) fairness, and (vii) social awareness.

Opinion surveys of professional investors could provide some guidance on the construction of corporate governance scores. McKinsey & Company's (2002) survey respondents say that, for corporations, timely and broad disclosure is the highest priority, followed by independent boards, effective board practices, and performance-related compensation for directors and management.

Investors' responses will, of course, reflect their major concerns given the realities in particular regions or countries. A survey by PricewaterhouseCoopers Indonesia and the Jakarta Stock Exchange (2002) reports that what Indonesian institutional investors value most highly includes the disclosure of related-party transactions and corporate governance practices. The existence of corporate governance codes and business ethics as well as the quality and independence of external auditors, audit committees, and commissioners and directors is also important. The existence of nomination and remuneration committees and the number of independent commissioners seem to be less essential for their investment decisions.

However, as Klapper and Love (2002) found, the effect of corporate governance on firm performance may vary depending on the country-specific level of investor protection. More specifically, firms with relatively good governance practices are likely to be more highly valued by investors in countries where investor protection is generally poor. Extending this argument, we can also expect the market to assess the same corporate governance differently depending on corporations' ownership and control structure. For instance, if the market suspects that controlling owners can find ways to maximize their interests at the expense of other shareholders however good their firms' corporate governance practices may appear then the market is likely to discount the value of measured corporate governance.

2.3. Cost of Capital

The cost of equity capital has been interpreted differently by different researchers in the literature. Some have used the ex-ante cost of equity while others are inclined to use the ex-post cost of equity. Most of the recent literature focuses on the use of the ex-ante approach to measuring the cost of equity. Various models have been employed to calculate the cost of equity. Ohlson and Nauroth (2005) use an EPS and EPS growth model. They have developed a model relating firm price per share with next year's expected earnings per share, and short-term growth in earnings per share with long-term growth in earnings per share. This model can be contrasted with the standard Gordan-Williams model (see Appendix C):

$$K = A + \sqrt{A^2 + \frac{e_1}{P_0}[g_2 - (y-1)]}$$

Another model used by Claus and Thomas (2001) is based on the residual income valuation approach. This is similar to the dividend discount model; the difference is that it uses future earnings per share with short-term and long-term growth rates. The model is represented by the following equation (see Appendix C):

$$P_T = B_T + \frac{EPS_{T+1} - KB_T}{(1+K)} + \frac{EPS_{T+2} - KB_{T+1}}{(1+K)^2} + \ldots\ldots + \frac{EPS_{T+5} - KB_{T+4}}{(1+K)^5} + \frac{(EPS_{T+5} - KB_{T+4})(1+gn)}{(K-gn)(1+K)^5}$$

Gebhardt, Lee, and Swaminathan (2001, referred to as GLS) use a model similar to the one used by Claus and Thomas, i.e., also based on the residual income valuation approach, the only difference being that, in the latter, growth was taken up to 5 years, while in the former, it was extended to 12 years.

Easton (2004, referred to as ES) base their calculations on an abnormal growth model, in which they use actual earnings forecasts for 2 years, dividend payout ratio, and current price, and manually search for the cost of equity capital (K) that leads to balancing the two sides of the equation. The equation is given below (see Appendix C):

$$P_T = \frac{EPS_{T+2} + KD_{T+1} - EPS_{T+1}}{M^2}$$

The above mentioned models are relatively new, but the foundations for the development of calculating cost of equity capital models were laid by Markowitz (1952) and Tobin (1958). Since then, various new models have emerged. The CAPM (capital assets pricing model), which has been used in this study, was developed by Sharpe (1964) and Lintner (1965), and relates the cost of equity capital of an individual security to a measure of its systematic risk (Beta).

Studies on the CAPM such as Lintner (1965) and Douglas (1969) were initially based on individual security returns. However, some statistical problems arose while calculating individual security-based returns which were identified by Miller and Scholes (1972) in testing the validity of the CAPM. Subsequent studies overcame this problem by using portfolio returns. Black, Jensen and Scholes (1972) use all the stocks of the NYSE spread over a time horizon, form portfolios, and report a linear relationship between the average excess portfolio return and the beta. Fama and

MacBeth (1973) extended the study and provided evidence (i) of a larger intercept term than the risk-free rate, (ii) that the linear relationship between the average return and the beta holds, and (iii) that the linear relationship holds well when the data are spread over a long time period.

2.4. Corporate Governance and Cost of Equity

Chen, et al (2007) investigated the effects of disclosure and other corporate governance mechanisms on equity liquidity and found that those companies with poor information transparency and disclosure practices face a greater economic cost of equity liquidity. With the same view, Ashbaugh, et al (2004) conjectured that, since governance attributes are intended to reduce agency costs, they should have a significant effect on firms' cost of equity capital; they found that the quality of firms' financial information is negatively related to firms' cost of equity.

Chen, et al (2004) examined the effects of firm-level disclosure and corporate governance on the cost of equity capital. They found that disclosure can significantly lower the cost of equity in emerging markets, and that this effect is observed only in countries that protect investors relatively well. Thus, firm-level disclosure and country-level legal protection seem to play a complementary role in reducing a firm's cost of equity. They further found that corporate governance always has a significantly negative effect on the cost of equity capital under various regression specifications. In addition, this effect is significant only in countries that provide relatively poor legal protection for investors.

Contrary to the above studies Guedhami and Mishra (2006) found robust evidence that the implied cost of equity increases with excess control. Another aspect of corporate governance was highlighted by Hope (2007) in his study on the impact of excessive auditor remuneration on the cost of equity, which found that the cost of equity increases if auditors' remuneration is excessive but only in countries with stronger investor protection.

Clearly, corporate governance has a great deal of influence on the cost of capital. We are interested in investigating the importance of corporate governance on the cost of equity in Pakistan, where regulatory authorities are attempting to promote good corporate governance among business sector entities.

3. Data and Methodology

3.1. Sample

The sample comprised 114 listed companies selected from the Karachi Stock Exchange (KSE)-listed companies spanning different sectors for the period 2003-2007. It excludes financial companies (because their capital structure and profits are different from other companies), and companies for which no data were available.

Sources of data included annual reports, the State Bank of Pakistan's balance sheet review, companies' web sites, and in certain cases direct contact with company officials.

The following table lists the total number of listed companies in each sector and the number chosen for our study:

Table-1

No.	Name of Sector	No. of Companies	Used in Study
1.	Sugar	40	16
2.	Cement	24	7
3.	Oil and Gas Marketing	7	1
4.	Textile Spinning	109	57
5.	Automobile Assembler	13	2
6.	Jute	6	1
7.	Oil and Gas Exploration	4	3
8.	Power Generation and Distribution	13	1
9.	Refinery	4	3
10.	Tobacco	3	2
11.	Fertilizers	5	4
12.	Pharmaceuticals	8	7
13.	Chemicals	25	7
14.	Food and Personal Care Products	23	1
15.	Miscellaneous	28	2
	Total	**312**	**114**

3.2. Methodology

The study's hypothesis is as follows:

H_0 = corporate governance does not impact the cost of capital

H_1 = corporate governance impacts the cost of capital

In order to test the hypothesis, the following methodologies have been used.

Since our objective is to measure the extent of the impact of corporate governance on a company's cost of equity, the latter is a dependent variable while the various aspects of corporate governance (practices) have been used as independent variables. As seen in the literature review, there are a number of factors that influence the cost of equity; we have used two control variables, namely return on equity (ROE) and size (log of total assets). Corporate governance is a qualitative variable, incapable of being measured directly. We have therefore used proxies for this purpose, each of which has its own limitations. The empirical literature provides a number of proxies used to quantify corporate governance. These range from the individual factor to the score card approach; the latter entails the combined effect of all factors of corporate governance. We have attempted to capture the effect of individual factors as well as the collective effect of the concerned variables.

3.3. Model Used to Measure Corporate Governance

In this paper, in line with Klapper and Love (2002), the quality of corporate governance (QCG) has been estimated by the use of following equation.

QCG = f (BS, OS, AI)

Where BS = board structure, OS = ownership structure, and AI = audit committee independence.

The theoretical framework of corporate governance measurement has been shown in the above equation. These variables have been used, once independently to use them as a proxy for corporate governance, and collectively in the calculation of the corporate governance score for each company. The method applied to estimate the corporate governance score (CGS) has been given in Appendix B.

3.4. Cost of Equity

The cost of equity capital has been calculated using CAPM in line with Fama and French. The equation used in the calculation is as follows:

$$Ke = R_{fr} + \beta(R_m - R_{fr})$$

Where Ke = cost of equity, R_{fr} = risk free rate, R_m = market rate and β = beta.

Beta (β) has been calculated on the basis of 2 years' monthly returns using the following formula.

$$\beta = Cov_{(Security\ \&\ Market)} / Var_{(Market)}$$

Return on equity (ROE) (net profit after tax/shareholders' equity) is a measure of the returns being earned by the company on shareholders' equity. It has been used as control variable in finding out the relationship because of its impact on the risk of the company. The higher the return on equity, the more comfortable the investors, and the lower the risk.

The log of total assets has been used as a proxy for firm size. Larger companies will have lower risks and investors will be more willing to accept lower returns from such companies.

4. Data Analysis and Results

Table-2: Descriptive Statistics (Corporate Governance Measured by Individual Factors)

	Ke	F/SIZE	OC	MO	BI	ACI	BS	ROE
Mean	0.29	18.57	0.99	0.37	1.08	1.24	1.83	0.36
Median	0.19	20.48	0.86	0.21	0.57	0.67	1.95	0.12
Maximum	-0.93	3.59	0.00	0.00	0.00	0.00	-9.21	-26.88
Minimum	1.91	25.15	80.43	27.33	14.00	66.67	2.89	39.30
Std. Dev.	0.36	5.20	3.44	1.64	2.21	6.22	0.89	2.49

K_e = cost of equity, F size = log of total assets, OC = ownership concentration, MO = managerial ownership, BI = board independence, ACI = audit committee independence, BS = board size, ROE = return on equity.

Descriptive statistics have been used to check the nature and range of the data, followed by the application of correlation analysis:

Table-3: Correlation Matrix (Corporate Governance Measured by Individual Factors)

	Ke	Log T Assets	OC	MO	BI	ACI	BS	ROE
Ke	1							
Log T. Assets	-0.1182***	1						
P values	0.005913							
OC	0.0157	0.0263	1					
P values	0.715596	0.541588						
MO	-0.0227	0.0005	0.8055***	1				
P values	0.598308	0.990743	0					
B.I.	0.0755	0.2432***	-0.0212	-0.0537	1			
P values	0.07934	0	0.622709	0.218412				
Audit	-0.0026	0.0413	-0.0043	-0.0232	-0.0311	1		
P values	0.962982	0.337659	0.920515	0.59348	0.471804			
Board size	-0.063	-0.1903***	0.0158	0.035	-0.6893***	0.0173	1	
P values	0.143356	0.000009	0.713864	0.416536	0	0.688062		
ROE	-0.0783	0.1351***	0.0015	0.0014	0.0248	0.0117	-0.0074	1
P values	0.06879	0.001635	0.972232	0.974083	0.564894	0.785995	0.863655	

Values marked with *** are significant at 0.01 significance level.

From the above correlation matrix it is clear that only BI and OC are positively correlated with Ke while all other variables including control variables are negatively correlated. P values are underlined to indicate the significance of the relationship.

A 5-year panel data of 15 different industries has been empirically analyzed. Two models have been used for the analysis and been compared as well. In the first instance, assuming that the basic assumptions of the classical linear regression model hold true, data have been analyzed using the OLS method according to the following equation. The results are shown in Table-4.

$$Y_{it} = \alpha_1 + \sum \beta_1 X_{it} + \mu_t$$

Where $\sum X_{it}$ is a set of independent variables and μ_t is the error term in year t.

The above equation can also be written as:

$Ke_{it} = \propto_1 + \beta1.Fsize + \beta2.OC_{it} + \beta3.MO_{it} + \beta4.BI_{it} + \beta5.ACI_{it} + \beta6.BS_{it} + \beta7.ROE_{it} + \mu_{it}$

Where Ke = cost of equity, F size = log of total assets, OC = ownership concentration, MO = managerial ownership, BI = board independence, ACI = audit committee independence, BS = board size, ROE = return on equity.

Table-4: OLS Method (Corporate Governance Measured by Individual Factors)

	Coefficient	**T values**
Intercept	0.469314106	6.275847641
Log T. Assets	-0.009447219	-3.238116858
OC	0.010429318	1.426068793
MO	-0.021240946	-1.381901397
BI	0.014588404	1.546201726
Audit	0.000306093	0.127622373
Board size	-0.010826306	-0.469008157
ROE	-1.59761E-06	-1.478101538
R Square	0.033687901	
Adjusted R Square	0.021651985	

Significance	
F	F
2.798947873	0.007174906

The value of R squared indicates that only 3.3% of variability is explained by the independent variables, which could be due to the nonconsideration of other variables which also impact the cost of equity. The adjusted R squared is not satisfactory, but as far as the F statistic is

concerned, it shows that model used is valid. From the above table, we observe that:

OC and BI are positively correlated with the cost of equity and have a slightly significant relationship,

- MO has a negative but slightly significant impact on the cost of equity,
- Among the control variables ROE does not have any significant impact on Ke,
- Firm size has a strong negative significant impact on the cost of equity.

The above analysis appears to yield certain confusing or conflicting results. One probable cause is the validity (or otherwise) of the assumptions used for the OLS method. For example, the slope coefficient may be constant but with a varying intercept across individual industries. On the other hand, the intercept may vary individually as well as over time or may be constant among individuals and vary across time. The fixed effect model has been applied to capture these possibilities:

$$Y_{it} = \alpha_{1i} + \sum \beta_1 X_{it} + \mu_{it}$$

The subscript $_i$ on the intercept means that the intercepts of the 15 industries may be different. This difference may be due to the special features of industries over time.

The above equation can also be written as

$$Ke_{it} = \propto_1 + \alpha_2.D_{1i} + \alpha_3.D_{3i+} + \_\_\_\_\_ + \alpha_{14}.D_{14i} + \beta_1.OC_{it} + \beta_2.MO_{it} + \beta_3.BI_{it} + \beta_4.BS_{it} + \beta_5.ACI_{it} + \beta_5.F\ Size_{it} + \beta_5.ROE_{it} + \mu_{it}$$

Where D_{1i}---D_{14i} are dummy variables which have been used to capture inter-industry intercept differences. Applying the test yields the following results:

Table-5: Fixed Effect Model (assuming intercept varies across individuals but constant over time)

Dependent Variable: Ke
Method: Least Squares
Included observations: 541 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OC	0.008672	0.007148	1.213163	0.2256
MO	-0.015291	0.015117	-1.011487	0.3123
BI	0.000375	0.014972	0.025030	0.9800
BS	-0.018172	0.010585	-1.716727	0.0866
ACI	0.000496	0.002349	0.211330	0.8327
F Size	-0.008912	0.003453	-2.581341	0.0101
ROE	-0.003841	0.005905	-0.650532	0.5156
D1	-0.015151	0.045571	-0.332477	0.7397
D2	-0.122913	0.114587	-1.072659	0.2839
D3	0.118906	0.085622	1.388741	0.1655
D4	-0.169461	0.065647	-2.581421	0.0101
D5	-0.069298	0.154917	-0.447324	0.6548
D6	0.016632	0.118951	0.139821	0.8889
D7	0.290684	0.106252	2.735802	0.0064
D8	0.303791	0.097343	3.120832	0.0019
D9	0.143424	0.156435	0.916827	0.3597
D10	0.293061	0.111274	2.633685	0.0087
D11	0.284533	0.176831	1.609068	0.1082
D12	0.157923	0.064544	2.446751	0.0147
D13	-0.014048	0.113779	-0.123471	0.9018
D14	0.148420	0.243748	0.608909	0.5429
C	0.563607	0.105402	5.347194	0.0000
R-squared	0.101047	Mean dependent var		0.289258
Adjusted R-squared	0.064673	S.D. dependent var		0.353618
S.E. of regression	0.341992	Akaike info criterion		0.731756
Sum squared resid	60.70146	Schwarz criterion		0.906350
Log likelihood	-175.9401	F-statistic		2.778009
Durbin-Watson stat	1.725534	Prob(F-statistic)		0.000046

By incorporating the representation of each industry, both the variation constant and adjusted R squared terms have been improved. This shows that, by adding other variables, variation can be removed. In this test:

- OC and BI still show a positive impact on cost of equity which is statistically insignificant.
- BS has a negative effect on cost of equity which is slightly significant.
- MO has a negative impact on cost of equity which is also insignificant.
- Audit committee independence has an insignificant positive impact on Ke.
- ROE has a negative impact on Ke but it is insignificant.
- Firm size still has a strongly negative significant impact on cost of equity.

The study covered 15 different industrial sectors. To avoid the dummy trap, we used 14 dummy variables, of which the majority of coefficients were found to be significant with very low p values. We also found that most industries in our analysis did not have similar coefficients.

In our second analysis using the fixed effects model, we assumed that the intercept varies across individuals as well as over time. The time factor was also included in the study as an acknowledgement of the fact that different economic policies and changes in the status of economic factors alter the relationship of CG and Ke.

The results of the model are shown in Table-6 and the equation given below.

$$Ke_{it} = \propto_1 + \alpha 1.D_{1i} + \alpha_3.D_{3i+} + \text{------} + \alpha_{14}.D_{14i} + \Upsilon_0 + \Upsilon_1.D15 + \Upsilon_2.D_{16} + \Upsilon_3.D_{17} + \Upsilon_4.D_{18} + \beta_1.OC_{it} + \beta_2.MO_{it} + \beta_3.BI_{it} + \beta_4.BS_{it} + \beta_5.ACI_{it} + \beta_5.F\ Size_{it} + \beta_5.ROE_{it} + \mu_{it}$$

Where $+\Upsilon_0 + \Upsilon_1.D_{04} + \Upsilon_2.D_{05} + \Upsilon 3.D_{06}$ are time dummies used to capture the differences in intercepts due to time.

Table-6: Fixed Effects Model (assuming intercept varies across individuals as well as over time)

Dependent Variable: Ke
Method: Least Squares
Date: 07/09/08 Time: 15:15
Sample (adjusted): 1 560
Included observations: 541 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OC	0.009031	0.006839	1.320418	0.1873
MO	-0.019821	0.014454	-1.371352	0.1709
BI	0.001087	0.014255	0.076250	0.9392
BS	-0.017244	0.010096	-1.708038	0.0882
ACI	0.000518	0.002236	0.231656	0.8169
F Size	-0.007805	0.003290	-2.371963	0.0181
ROE	-0.007397	0.005653	-1.308590	0.1913
D1	-0.020748	0.043397	-0.478102	0.6328
D2	-0.114318	0.109088	-1.047943	0.2952
D3	0.107284	0.081545	1.315631	0.1889
D4	-0.173484	0.062499	-2.775778	0.0057
D5	-0.074463	0.147474	-0.504926	0.6138
D6	0.012635	0.113274	0.111542	0.9112
D7	0.283723	0.101211	2.803281	0.0052
D8	0.298333	0.092695	3.218418	0.0014
D9	0.140985	0.148926	0.946675	0.3442
D10	0.288391	0.105930	2.722471	0.0067
D11	0.266340	0.168438	1.581237	0.1144
D12	0.152136	0.061448	2.475861	0.0136
D13	-0.022539	0.108327	-0.208066	0.8353
D14	0.133342	0.232044	0.574640	0.5658
D15	-0.034090	0.044701	-0.762622	0.4460
D16	-0.121179	0.044390	-2.729852	0.0066
D17	-0.211534	0.044434	-4.760681	0.0000
D18	-0.287148	0.044799	-6.409670	0.0000
C	0.671531	0.102991	6.520305	0.0000
R-squared	0.191649	Mean dependent var		0.289258
Adjusted R-squared	0.152408	S.D. dependent var		0.353618
S.E. of regression	0.325557	Akaike info criterion		0.640310
Sum squared resid	54.58360	Schwarz criterion		0.846648
Log likelihood	-147.2037	F-statistic		4.883971
Durbin-Watson stat	1.715653	Prob(F-statistic)		0.000000

When variations in time are incorporated with variations in intercepts, all the results remain the same, e.g., BS is still slightly statistically significant with a negative effect on cost of equity while the other governance variables have insignificant results. Only the R-squared and adjusted R-squared terms show any improvement. The entire coefficient taken from time varying coefficients is significantly different, which means that the results obtained for the remaining years are different from those of the excluded dummy year.

4.1. Corporate Governance Impact on Cost of Equity using CGS

We have analyzed the impact of individual factors of corporate governance on the cost of equity. Next, we analyze the impact of corporate governance using the CGS approach. First, we perform a descriptive analysis, the results of which are shown in the following table:

Table-7: Descriptive Statistics

	Ke	Log T. Assets	ROE	CGS
Mean	0.291555	18.5705	0.357792	5.625714
Median	0.186058	20.47534	0.115425	5.6
Minimum	-0.9253	3.589059	-26.8788	2.6
Maximum	1.906467	25.14992	39.30193	8.2
Standard Error	0.015071	0.219629	0.105024	0.044234

Then we performed a correlation analysis to investigate the relationship between companies with good or bad corporate governance and the cost of their equity. Results indicate that companies with better corporate governance scores have a higher cost of equity.

Table-8: Correlation Matrix

	Ke	Log T. Assets	ROE	CGS
Ke	1			
Log T. Assets	-0.10912**	1		
P values	**0.011182**			
ROE	-0.03533	0.044226	1	
P values	**0.416536**	**0.304802**		
CGS	0.032058	0.191927***	-0.02377	1
P values	**0.457621**	**0.000007**	**0.59348**	

Values marked with *** are significant at 0.01 and marked with ** are at 0.02.

The fixed effect model is represented by the following equation:

$$Y_{it} = \alpha_{1i} + \sum \beta_1 X_{it} + \mu_{it}$$

The subscript i on the intercept means that the intercepts of the 15 industries sampled may be different, due to industry-specific features.

The above equation can also be written as

$$Ke_{it} = \propto_1 + \alpha_2.D_{1i+}\alpha_3.D_{3i} + \ldots\ldots + \alpha_{14}.D_{14i} + \beta_1.Fsize + \beta_2.CGS_{it} + \beta 3.ROE_{it} + \mu_{it}$$

Where D_{1i} through D_{14i} are dummy variables which have been used to capture inter-industry intercept differences. Applying the test yields the following results:

Table-9: Fixed Effect Model (assuming intercept varies across individuals but constant over time)

Dependent Variable: Ke

Included observations: 557 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CGS	0.001754	0.016120	0.108786	0.9134
F Size	-0.010334	0.003263	-3.166696	0.0016
ROE	-0.004150	0.005931	-0.699722	0.4844
D1	-0.022417	0.045168	-0.496309	0.6199
D2	-0.132825	0.115499	-1.150005	0.2507
D3	0.092572	0.082512	1.121920	0.2624
D4	-0.186462	0.064312	-2.899325	0.0039
D5	-0.062453	0.155865	-0.400688	0.6888
D6	-0.059119	0.112334	-0.526282	0.5989
D7	0.196598	0.096884	2.029207	0.0429
D8	0.246850	0.092446	2.670217	0.0078
D9	0.101780	0.156699	0.649524	0.5163
D10	0.297796	0.111990	2.659120	0.0081
D11	0.154763	0.157639	0.981751	0.3267
D12	0.188253	0.062387	3.017503	0.0027
D13	0.116288	0.064901	1.791767	0.0737
D14	0.283003	0.158130	1.789681	0.0741
C	0.449023	0.099138	4.529288	0.0000
R-squared	0.095270	Mean dependent var		0.291687
Adjusted R-squared	0.066735	S.D. dependent var		0.356311
S.E. of regression	0.344217	Akaike info criterion		0.736692
Sum squared resid	63.86353	Schwarz criterion		0.876380
Log likelihood	-187.1688	F-statistic		3.338708
Durbin-Watson stat	1.700904	Prob(F-statistic)		0.000008

By applying the analysis using the CGS, we observed that corporate governance has a positive impact on cost of equity but that this relationship is not significant. While both returns on equity and size of firm have a negative relationship with the cost of equity, only firm size has shown a significant relationship. Most dummies' coefficients have been found significant with very low p values. This indicates that most of the industries in our analysis have dissimilar coefficients.

Just as individual factors have been analyzed using time and intercept variances, the CGS has also been analyzed using the following equation to capture the time variance effect.

$$Ke_{it} = \propto_1 + \alpha 1.D_{1i+}\alpha_3.D_{3i} + \ldots\ldots\ldots + \alpha_{14}.D_{14i} + \Upsilon_0 + \Upsilon_1.D_{15} + \Upsilon_2.D_{16} + \Upsilon_3.D_{17} + \Upsilon_4.D_{18} + \beta_1.CGS_{it} + \beta 2.F\ Size_{it} + \beta 3.ROE_{it} + \mu_{it}$$

Where $D_{15}+D_{16}+D_{17}+D_{18}$ are time dummies used to capture the difference of intercept due to time.

Table-10: Fixed Effects Model, (assuming intercept varies across individuals as well as over time)

Dependent Variable: Ke
Method: Least Squares
Date: 07/09/08 Time: 15:19
Sample (adjusted): 1 560
Included observations: 558 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CGS	0.002789	0.015236	0.183075	0.8548
F Size	-0.009429	0.003111	-3.030566	0.0026
ROE	-0.007737	0.005680	-1.362077	0.1737
D1	-0.029397	0.042812	-0.686658	0.4926
D2	-0.125856	0.110009	-1.144047	0.2531
D3	0.085427	0.078612	1.086692	0.2777
D4	-0.188081	0.061263	-3.070074	0.0022
D5	-0.067580	0.148487	-0.455128	0.6492
D6	-0.059342	0.106998	-0.554610	0.5794
D7	0.193883	0.092219	2.102432	0.0360
D8	0.244515	0.088054	2.776876	0.0057
D9	0.100797	0.149267	0.675280	0.4998
D10	0.294447	0.106685	2.759961	0.0060
D11	0.146973	0.150178	0.978662	0.3282
D12	0.183917	0.059437	3.094301	0.0021
D13	0.108948	0.061823	1.762253	0.0786
D14	0.273392	0.150636	1.814923	0.0701
D15	-0.028453	0.044026	-0.646281	0.5184
D16	-0.111762	0.043993	-2.540413	0.0114
D17	-0.197570	0.044045	-4.485659	0.0000
D18	-0.286350	0.044274	-6.467691	0.0000
C	0.554796	0.097005	5.719275	0.0000
R-squared	0.183519	Mean dependent var		0.291560
Adjusted R-squared	0.151530	S.D. dependent var		0.356004
S.E. of regression	0.327924	Akaike info criterion		0.646558
Sum squared resid	57.63830	Schwarz criterion		0.817053
Log likelihood	-158.3898	F-statistic		5.736939
Durbin-Watson stat	1.687970	Prob(F-statistic)		0.000000

The results are the same as has been discussed while keeping time constant and varying the intercept over individual variables. The coefficients of time are significantly different from each other. The R-squared and

adjusted R-squared terms have also been improved by taking the time effect into consideration.

5. Discussion of Results

Our study leads us to the following conclusions:

a. Board size is negatively related to the cost of equity, i.e., a larger board brings down the cost of equity. This can be explained by the argument that when the board size is large, no single stakeholder can dominate its decision-making process. Its first impact is on the reduction of agency costs. Better decisions taken by a nonpartisan board for the overall good of all stakeholders also improve the image of the company. In turn, these factors lower the company's risk profile and curtail the cost of its equity.

b. Managerial ownership has a negative impact on a company's cost of equity, i.e., a higher number of shares (as a percentage of the company's total issued shares) held by board members leads to a higher cost of equity. Conversely, if the percentage of shareholding commanded by board members is low, the cost of company's equity is low. This can be explained by the fact that if a board is not dominated by one group of shareholders, it is likely to have a more balanced and representative structure. A balanced board reduces the possibilities of lopsided decision making, preventing any particular class of stakeholders from furthering its interest at the expense of other stakeholders. In turn, it leads to better image, lower risk profile, and lower cost of equity.

c. Surprisingly, board independence and audit committee independence were found to have a positive although insignificant effect on a company's cost of equity. One would generally expect board independence and the presence of an independent audit committee to lower a company's risk profile and hence the cost of its equity. Yet, in our sample, our findings were not consistent with this generally held view. However, there is a plausible explanation for this distortion. In Pakistan, neither the law nor practice draws any distinction between independent nonexecutive directors (INEDs) and nonexecutive directors (NEDs). Pakistani companies thus invariably classify their NEDs as INEDs. This explains why investors may be oblivious of the so-called independence of the board (as indicated by number of NEDs on the board). This theory is also sustained by the rather insignificant relationship between board/audit committee

independence and cost of equity. The other reason here could be that our data are dominated by the spinning sector. Most firms in this sector are *seth* (**) owned, the presence of whom is likely to limit the independence of NEDs. We believe a more detailed investigation is needed in this area, for which one would need to determine the true level of independence of boards (and audit committees) with access to accurate statistics on the number of truly independent directors on each board. This task cannot be accomplished by analyzing only published financial statements.

d. Firm size and return on equity have been found to be negatively related to the cost of equity. This is hardly surprising as larger and more profitable firms are deemed to carry lower risk and therefore enjoy greater public confidence, leading to lower demand for returns by investors.

e. An important albeit conflicting observation emerges from our study. When these variables were analyzed collectively to reveal their impact on cost of equity using the CGS, it was found to be positively but insignificantly correlated with cost of equity. This would imply that the CGS has no impact on cost of equity. The CGS takes into account a number of aspects of corporate governance performance, with each individual aspect having its own distinct impact on the cost of equity. We believe that the overall insignificant impact of the CGS on COE is caused by the positive impact of certain individual aspects of CG being offset by the negative impact of other factors. Another reason for this apparently conflicting result could be the selection of our sample, which includes a large number of firms from the textile sector. Most firms in this sector are family-owned businesses, who, in this part of the world, are not known to have any real regard for good corporate governance. The investing public is therefore generally oblivious to the CGS of such firms, explaining partially the insignificance of the relationship between CGS and cost of equity.

5. Conclusion and Recommendations

In this study, comprehensive data have been used to investigate and analyze the relationship between corporate governance and cost of equity. Good corporate governance is rightfully seen as the most important task of today's regulators, planners, industry leaders, and managers. On the other hand, the cost of equity is the axis on which revolves the prospects of a

company's growth and expansion. Formally exploring the relationship between these important aspects of the economy has been opportune and timely.

We conclude that good corporate governance reduces a company's cost of equity. This in turn facilitates decision-makers in considering new investments in feasible projects. Investors show greater faith in companies that have a consistent profitability profile and a large assets base.

As mentioned earlier, one important aspect of corporate governance that has been highlighted by this study is the fact that boards and audit committees are not as independent in Pakistan as the development of a good corporate governance culture would demand. One reason for this could be that the data are skewed toward the spinning sector, in which most companies are family-owned. Another reason for this state of affairs is the absence of a clear definition of INEDs in Pakistan. Companies are inclined to label all NEDs as independent at will. We believe there is an immediate need for the law to come up with a precise and enforceable definition of INEDs, and for regulators to ensure that it is properly followed. With the emergence of truly independent directors, who act not for a particular stakeholder but for the collective interest of all stakeholders, companies will become more transparent in their decision making. In turn, this should lead to better corporate governance and greater investor confidence in listed companies.

Based on the findings of this study, we recommend the following:

1. This study, as well as the literature reviewed for the purpose of the study, shows that there is an urgent need to introduce and effectively enforce laws for better corporate governance in Pakistan. Better corporate governance will bring down the cost of equity, leading to greater investment in new projects, bringing about greater overall development for the economy. The Code of Corporate Governance 2002 should be revised to encompass more stringent measures and be made mandatory for all listed companies.

2. Our study was limited in one particular respect: the aspects of good corporate governance included in the CGS. These were limited principally due to nonavailability of data from published sources on all aspects of corporate governance. We believe that, by considering a greater volume of data and including more variables in the CGS, more reliable results can be obtained. The study leaves room for further research on the topic by including more variables in the CGS and calculating Ke using other available models.

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Appendix-A

Company Name

			Period covered
Symbol	**Variable**	**Definition**	**2006**
OWNCON j,t	Ownership Concentration	Percentage of total shares held by the top 20 shareholders divided by the total number of shares.	
OWNMANj,t	Managerial Ownership	Percentage of total shares held by executive directors divided by the total number of shares.	
BRDINDjt	Board Independence	independent directors divided by the total number of Directors	
BRDSZEjt	Board Size	Number of directors on the board.	
AUDINDjt	Audit Committee Independence	Number of independent directors on the audit committee divided by the total number of directors on the audit committee.	

Appendix-B

Scoring Criteria and their weights
Presence of INED's in the Board & In Audit Committee: Weight 55%

Board Structure:

Directors are governor of companies. Therefore board structure is core issue of corporate governance. A balanced and effective board is considered essential for good governance.

1. Number of INEDs:

Range	Score
0%--------20%	1
21%-------- 40%	2
41%---------60%	3
61%---------80%	4
81% and above	5

2. No. Of INEDs in Audit Committee:

Range	Score
0%--------20%	1
21%-------- 40%	2
41%---------60%	3
61%---------80%	4
81% and above	5

Ownership structure (Weight 45%)_

1. Ownership Concentration

Range	Score
0%--------20%	5
21%-------- 40%	4
41%---------60%	3
61%---------80%	2
81% and above	1

2. %age of shares held by Board of Directors

Range	Score
0%--------20%	5
21%-------- 40%	4
41%---------60%	3
61%---------80%	2
81% and above	1

Appendix-C

Ohlson and Jeuttner Nauroth (2005)

$$K = A + \sqrt{A^2 + \frac{e_1}{P_0}[g_2 - (y-1)]}$$

Where

K = cost of equity
A = $[(y\text{-}1) + D1/P_o]$
e_1 = Earnings per share for year 1
$g_2 = e_{2-}\ e_{1/}\ e_1$
e_2 = Earnings per share for year 2
Y = constant (1+ growth rate g)
D1 = e_1 * dividend payout ratio.

Claus and Thomas (2001)

$$P_T = B_T + \frac{EPS_{T+1} - KB_T}{(1+K)} + \frac{EPS_{T+2} - KB_{T+1}}{(1+K)^2} + ..+ \frac{EPS_{T+5} - KB_{T+4}}{(1+K)^5} + \frac{(EPS_{T+5} - KB_{T+4})(1+gn)}{(K-gn)(1+K)^5}$$

Where

P_T = Price per share
B_T = Current Book Value
EPS_{T*J} = Forecast of future earnings per share
g_n = long term growth rate
K = cost of equity capital
$B_{T+I} = B_{T+i-1} + EPS_{T+i} - P_{T+i}$

Easton (2004)

$$P_T = \frac{EPS_{T+2} + KD_{T+1} - EPS_{T+1}}{M^2}$$

Where

D_{T+i} = EPS_{T+i} * Dividend payout ratio

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The Lahore Journal of Economics
14 : 1 (Summer 2009): pp. 173-175

Book Review

Yunus, Muhammad with Alan Jolis, *Banker to the Poor, The Story of Grameen Bank*, Aurum Press Ltd, London, 1998, ISBN 978-1-85410-924-8, pp 313, Price: UK Pounds 8.99.

It is the firm conviction of Muhammad Yunus, winner of the Nobel Peace Prize, that poverty can be eradicated and put away in museums once and for all. As the author puts it, the bottom line of his belief system is that 'poverty does not belong in a civilized human society. It belongs in museums'. This is what motivated this stalwart to establish the Grameen Bank in Bangladesh, the pioneer in the field of micro-finance for the poor. Today, Grameen Bank can boast that it provides 2.5 billion dollars of micro-loans to over two million rural poor in the country.

The book is essentially the memoirs of Yunus charting the obstacles along the way, and with the sheer will and perseverance of the founder and his staff, resulted in it becoming a success story. Yunus started out as an ordinary university professor, when the idea struck him that people were poor because the financial system which could help them simply did not exist in Bangladesh.

To this end, he carried out lengthy `battles' with the World Bank and local banks in his own country, to try and sell them the idea of microcredit loans for the less privileged. Some of his efforts reaped good harvests, but more often than not they proved exercises in futility. In discussing his interaction with the World Bank, he provides startling insights into the workings of multilateral aid agencies, for instance, in how aid projects in the developing world give rise to enormous bureaucracies that are corrupt and inefficient and end up incurring significant losses. As he states, if aid is sent to a country such as Bangladesh, it is invariably used to build roads and bridges and such like, which the government claims will help the poor in the `long run'. But, continues Yunus, in the long run we are all dead and nothing trickles down to the poor. The author firmly believes that development aid should aim at directly eradicating poverty, and that development should be regarded as a human rights issue and not one of merely GNP growth. The idea behind all aid is the `bigger the better', with scant regard for the quality of the assistance.

While working with the poor over the years, the author dispels many myths and clichés about the poor, such as that the poor are not creditworthy, that they cannot save, that the poor need to be trained before

they can undertake any income-generating activity, and that poor women have no skills and so it is futile to talk about programs for them. From his first-hand experience, he also provides several hard-hitting home truths about the actual predicament of the poor.

Grameen believes in reaching out to women borrowers rather than males as it was felt that credit given to women worked faster than credit given to their male counterparts. Yunus then devotes a chapter to the problems encountered in setting up the bank and extending loans, especially to poor women. He discusses the social stigma attached to women receiving loans and the resistance they met with in lending to destitute women. The author tells the tale of many a woman borrower whose life was doomed till the day she received a micro-loan, which proved a window of opportunity for improving her plight.

What then is the actual repayment mechanism of micro finance that Grameen employs? The philosophy they follow is to maximize operational simplicity. The mechanism is so simple that all borrowers understand it immediately.

-1-year loans
-equal weekly installments
-repayment commences one week after the loan is granted
-interest rate of 20%
-repayment amounts to 2% per week for 50 weeks
-interest payment totals to 2 taka per week for a 1,000 taka loan.

Loans are given for income-generating work and initially it was decided to influence the clients on their choice of work. The principle of the Grameen Bank system is that the people should not have to go to the bank, rather the bank should go to the people. In comparing Grameen to conventional banks, Yunus states that the difference for one, lies in the fact that their clients do not need to show how large are their savings and how wealthy they may be, instead they need to prove how poor they are and how meagre are their savings. Further, the success of the bank is gauged not by bad debt figures or repayment rates, although this is necessary for their internal records, but whether or not the lives of the clients have improved and they have been extricated from the evils of poverty.

The author's economic philosophy is another chapter of great interest. Although not considering himself to be a follower of capitalism per se, he does believe in the global free market economy and the power of the free market. He does not think it right to offer unemployment benefits to

redress the problem of the poor. All the poor need, he holds, is financial capital. He also advocates competition as a driving force for all innovations. Yunus proposes that we replace the limited profit maximization principle of capitalism with a generalized principle – an entrepreneur who maximizes both profit and social returns. In this way an entrepreneur could run social services such as a health care service for the poor, if financially viable. Such entrepreneurs would be steeped in social consciousness. A willing suspension of disbelief is called for here, as even though one would wish to endorse his views on the goodness of human nature, sadly his philosophy seems to border on the idealistic and ephemeral rather than being a true depiction of man's inherent nature.

Yet, so successful has been this venture that it has been replicated with greater or lesser success in other countries of Asia, Africa, Latin America and now even in the US. It has also expanded its spheres of activities to ventures such as housing loans, fisheries and retirement schemes.

To conclude, a word on Pakistan's experience with micro finance. Unfortunately this has not been as salubrious as the experience of Bangladesh thus far, for whatever reason. Yet the intended outreach this fiscal year is 3 million poor, up from last year's 2 million.

We all live with rampant poverty and our reaction is invariably one of apathy, indifference or resignation that individually there is very little if at all we can do about it. Yunus is that rare individual who not only believes that the evil of poverty can be eradicated but has devoted his entire life's work to realizing this dream.

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