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INCOME DISTRIBUTION, GROWTH AND FINANCIAL DEVELOPMENT
A Cross Countries Analysis

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Abstract. Income inequality is an important economic issue faced by most of the developed and developing countries. Many attempts have been made to identify a link between economic growth and income inequality in the past. However, the literature is not conclusive about the relationship between economic development and income inequality. This study attempts to analyze the factors responsible for income inequality among the different groups of countries at different stages of economic growth and test the Kuznet's hypothesis by breaking panel of countries into four sub-panels; low income, lower middle income, upper income and higher income countries. In this study a larger set of variables are utilized for investigating the cross country differences in income inequality. The results of the study find the evidence of the existence of inverted U-shaped hypothesis for income growth. Financial development reduces the inequalities in income distribution irrespective of stage of development, and hence negates the inverted U-shaped relationship between inequality and financial development.

I. INTRODUCTION

The concern about inequality goes back to Kuznet's (1955) a seminal study, which argues that there is an inverted U-shaped relationship between income inequality and economic development; it means inequality first increases with economic development and then decreases. According to him, as

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industrial sector expands people engaged in industrial sector move from low income to high income. However, as agriculture sector shrinks and wages increase, it results into lower income inequality. Many attempts have been made to identify a link between growth and income inequality since then. However, the literature is not conclusive about the relationship between economic development and income inequality. Although, several early studies find support for Kuznet's hypothesis (*e.g.*, Pauker, 1973; Ahluwalia, 1976), but later research fails to find economic development affecting the income distribution (*e.g.*, Anand and Kanbur, 1993; Deininger and Squire, 1998; Ravallion, 1995).

It is argued that at given level of income, more equal income distribution would be associated with a low rate of poverty. Moreover, income distribution might itself be detrimental to long run growth (Alesina and Rodrik, 1999; Birdsall *et al.*, 1994; Deininger and Squire, 1998; Perrosson and Tabellini, 1994; Slyuester, 2000; Easterly, 2001). The most common argument is that an unequal distribution of income creates pressure for redistribution policies and therefore, distorts incentives for work and investment. It leads to abuse of power and thus harms investment environment and finally in the presence of imperfect markets, it also reduces opportunities for accumulating human capital and physical assets. So in order to tackle income inequality, policy makers must have knowledge of factors responsible for inequality.

There is a vast amount of literature available on determinants of income inequality both considering individual as well as at macro level factors affecting income inequality (Li, Squire and Zou, 1998; Li, Xu and Zou, 1999; Lundberg and Squire, 2003; Foster and Szekely, 2001; Clark *et al.*, 2003; Beck *et al.*, 2004). The most important factors responsible for income inequality, figured out by literature, are economic development, financial market development, government expenditures (size of public sector), education, inflation, population growth and openness.

This study is an attempt to bring out factors responsible for income inequality among the countries, test the Kuznet's hypothesis by breaking our panel into four sub-panels, *i.e.* (*i*) low income, (*ii*) lower middle income, (*iii*) upper income and (*iv*) higher income countries. Ordinary least square method is used for estimation for whole panel of countries and for different groups of countries using pooled data.

This study is divided into five sections. Section I gives us the introduction and brief review of the literature on the issue. Section II presents the determinants of income inequality on theoretical basis. Section III covers

the model specification and data description. Section IV presents empirical results, while section V concludes the discussion.

II. DETERMINANTS OF INCOME INEQUALITY

This section explains the affect of different factors like economic development, government involvement in the economy, structural changes and political as well as social factors on the distribution of income. The main factors responsible for income inequality are explained below:

1. Economic Growth

The main factor affecting income inequality is the economic growth. The relationship between income inequality and economic growth has received a lot of attention from the researchers. The impact of economic growth on the income inequality is ambiguous. For example, Kuznet suggested a U-shaped relationship between economic growth and income inequality, while Paukerit (1973) and Ahluwalia (1976) support the Kuznet's point of view. But some later studies (Deininger and Squire, 1998; Ravallian, 1995) do not find economic growth affecting income distribution. The literature has taken the issue in reverse direction also which means causality may run in reverse direction from inequality to economic growth. It is argued that on one hand income inequality is good for economic growth as it reduces the cost of mobilizing capital but, on the other hand, it is bad for economic growth due to constraints on the poor in financial markets. It also reduces demand for financial institutions, which are considered to be necessary for economic development in the long run. Golar and Zeira (1993), Benabou *et al.* (1996), Durlauf (1994), and Banerjee and Newman (1993) analyzed the effect of income inequality on long run growth through human capital accumulation theoretically. While Persson and Tabellini (1994) and Perotti (1996) establish a negative relationship between inequality and growth. Their findings have also revisited by Barro (2000). However, Banerjee and Duflo (2000) and Iyigun and Owen (2004) found inverted U-shaped function of changes in inequality.

2. Financial Development

Financial market has also an effect on income inequality. Theory provides different hypothesis concerning the financial development and income inequality. Some theories (Banerjee and Newman, 1993; Galor and Zeira, 1993; Aghion and Bolton, 1997) claim that financial intermediary development is pro-poor. Lamoreaux (1986), Haber (1991), Maurer and Haber (2003), on the other hand, argued that at early stage of financial

deepening access to financial services is limited to incumbents and will thus raise their income relevant to income of poor. Other model (Greenwood and Jovnovie, 1990), posit a non-linear inverted U-shaped relationship and income distribution.

3. Inflation

Inflation may have a strong redistribution effect which could be positive (through its effects on individual income wealth) or negative (through a progressive tax system). It is also argued that higher rate of inflation hurts the poor and middle class, relatively more than rich, because later have better excess to financial markets that allow them to hedge their exposure to inflation.

4. Government Consumption

Government Consumption is also one of the factors affecting income inequality. Income inequality may increase or decrease with government consumption. If most of redistribution through tax and transfer system is toward poor, government consumption might result into greater inequality. However, it could have opposite effects if government consumption is not developmental (it means not pro-poor). Cross countries studies (Stock, 1978; Boyd, 1988), found the size of public sector to be significant in reducing the income inequality. Higher unemployment also results into higher income inequality. Higher income inequality hurts the workers.

5. Population Growth

Difference in population growth is another factor explaining inter-country variation in income inequality. Although population growth generally declines as per capita income rises, there is considerable variation in population growth rate among the countries at similar income level. Generally, it is believed that faster population growth is associated with higher income inequality. One of the reasons is that dependency burden may be higher for poor group.

6. Education

One of the most important factors underlying the income inequality is level of access to education. There is two-way link; on the one hand an unequal educational opportunity leads to greater inequality in income distribution by widening the skilled and productivity gap in the working population. On the other hand unequal income distribution tends to prevent the poor investing in education and acquiring skill.

7. Openness of the Country for Foreign Trade

A number of studies have attempted to relate trade policy variables to economic growth (Dollar, 1992; Sachs and Warner, 1995; Edwards, 1992). These studies found that trade openness is associated with more rapid growth. Dollar and Kraay (2004) found evidence in support of the view that globalization leads to faster economic growth and a reduction in income inequality.

III. MODEL SPECIFICATION AND ESTIMATION

In the light of previous discussion our base model specification is

$$GINI_{(it)} = \alpha_{(i)} + \beta_0 PGDP_{(it)} + \beta_1 FIN_{(it)} + \beta_2 INF + \beta_3 UNEMP_{(it)} + \beta_4 CG_{(it)} + \beta_5 Edu_{(it)} + \beta_6 POPG_{(it)} + \beta_7 OPP_{(it)} + \varepsilon_{(it)}$$

GINI is Gini coefficient of income inequality, PGDP is per capita income growth, FIN is financial development,[1] INF is rate of inflation, UNEMP is unemployment rate, CG is government consumption, EDU is literacy rate of adults, POPG is population growth and OPP is openness,[2] and $\varepsilon_{(it)}$ is error term such that $\varepsilon_{it} \sim$ IID (0, σ^2 for all i and t) that is for a given country observations are serially uncorrelated and across the country and time the errors are homoscedastic.

Many studies tried to test U-shaped relationship between income inequality and other variables by using either cross sectional or time series data; however, as pointed out by Deininger and Squire (1998), the longitudinal data are needed to see whether income inequality changes with its potential determinants. The early study in this regard used square of variables to account for quadratic relationship (Kuznet's hypothesis) between income inequality and other variables. It is appropriate to check whether income inequality increases with increase in the variables mentioned in the above model and then decrease afterwards. But it is not appropriate to test whether inequality increases at early stage (*e.g.* economic or financial development) and decrease at later stage. We divide the panel of countries into four sub panels to check the inverted U-shaped relationship between variables mentioned in the model.

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[1]FIN is calculated as: M2/GDP.

[2]OPP is defined as: (Exports + Imports) / GDP.

DATA DESCRIPTION

The data are taken from World Development Indicators (WDI) and International Financial Statistics (IFS) CD ROM 2005. Since data on Gini coefficient are survey data, collected in different years for different countries, we take average of the other variables to year for which Gini coefficient is available for specific countries. In this study, data are taken for the period 1975 to 2002 on fifty-one countries. We get one to three observations (one for some countries, two and three for others) for each country and use this pooled data for analysis.[3] This gives us how different variables on average effect income distribution over a period.

IV. EMPIRICAL RESULTS

We estimate our model for all countries included in this study using ordinary least square method as well as by dividing these countries in four groups, *i.e.* low income countries (LIC), lower middle income countries (LMIC), upper middle countries (UMIC) and high income countries (HIC).[4] In this section the empirical results for each group as well as for all countries are presented and discussed. The model is estimated for each group separately to test the inverted U hypothesis by including all the variables in model and excluding variables which are statistically insignificant (*t* values less than 1), except per capita growth and financial development (our main variables) one by one. Tables 1 to 6 represent the empirical results when all the insignificant variables are excluded.

Table 1 shows that after excluding the insignificant variables one by one, per capita growth and population growth become significant besides the government consumption and financial development. Both government consumption and financial development carry negative sign, which implies that both of these variables reduce income inequality. Per capita income growth and population growth have positive sign showing that any increase in these variables will results in high-income inequality.

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[3]Table of countries with number of observations is given in Appendix.

[4]The countries are divided into groups on the basis of World Bank estimates of per capita GNI during 2000, *i.e.* low income if per capita GNI $\leq$ 755 US \$, lower middle income if 756 \$ $\leq$ per capita GNI $\leq$ 2955 \$, upper middle if 2996 \$ $\leq$ per capita GNI $\leq$ 9265 \$ and high income if per capita GNI $\geq$ 9266 \$.

TABLE 1

Determinants of Income Inequality in Low Income Countries

Variable	Coefficient	Std. Error	t-Statistic
C	54.24206	8.781059	6.177167
CG	–21.84433	9.118678	–2.395558
FIN	–64.01283	23.58934	–2.713635
PGDP	1.220781	1.170007	1.043396
POPG	3.948892	1.633935	2.416798

R-squared = 0.738735; F-statistic = 5.655072

After the exclusion of statistically insignificant variables, the results for lower middle-income countries are presented in Table 2. The results indicate that the openness and financial development reduce income inequality as they carry negative sign. The sign of unemployment rate is positive which indicates that higher unemployment will result into higher income inequality. While the sign of per capita income growth is positive but statistically insignificant which means that this variable has no significant impact on income inequality.

TABLE 2

Determinants of Income Inequality in Lower Middle Income Countries

Variable	Coefficient	Std. Error	t-Statistic
C	47.38522	4.561439	10.38822
FIN	–5.313076	5.171368	–1.027403
OPP	–13.19634	5.019388	–2.629073
PGDP	0.354076	0.637057	0.555800
UNEMP	0.356663	0.316652	1.126355

R-squared = 0.621778; F-statistic = 5.208601

Table 3 provides the results for upper-middle income countries. Financial developments, government consumptions and literacy rate carry negative sign which indicates that these variables reduce income inequality. Population growth carries positive sign which is statistically significant. It indicates that population growth increases the income inequality in the

upper-middle income countries. Per capita income growth has a positive sign which is statistically insignificant, indicates that this variable has no significant impact on the income inequality.

TABLE 3

Determinants of Income Inequality in Upper Middle Income Countries

Variable	Coefficient	Std. Error	t-Statistic
C	80.11728	23.40678	3.422824
FIN	–27.38087	8.585770	–3.189100
CG	–5.685175	5.365235	–1.059632
EDU	–0.362736	0.236809	–1.531767
PGDP	0.155950	0.660577	0.236082
POPG	6.158690	1.397179	4.407947

R-squared = 0.653724; F-statistic = 9.061788

Table 4 shows the results for high-income countries after the insignificant variables are dropped. Government consumption, inflation, literacy rate reduces income inequality. Population growth and unemployment increase income inequality in high income countries. The sign of financial development is negative but statistically insignificant, while the negative sign of per capita growth indicates that any increase in per capita growth is good for income to be distributed equally.

TABLE 4

Determinants of Income Inequality in High Income Countries

Variable	Coefficient	Std. Error	t-Statistic
C	70.55923	24.89303	2.834497
INF	–0.000181	0.000154	–1.176006
CG	–57.57043	22.46519	–2.562650
FIN	–0.158824	0.397172	–0.399888
EDU	–0.308798	0.232200	–1.329879
PGDP	–0.841554	0.681645	–1.234593
POPG	2.244908	1.803155	1.244989
UNEMP	0.379794	0.267399	1.420323

R-squared = 0.582959; F-statistic = 5.668804

From the above discussion, it can be observed that the sign of per capita income growth is positive for LICs (low income countries), LMICs (lower middle income countries) and UMICs (Upper middle income countries), while negative for HIC (high income countries), which provides evidence, though weak, for the existence of inverted U-shaped relationship between income inequality and per capita income growth. However, the sign of coefficient of financial development is negative for all the four groups, which indicates that financial development is good for even distribution of income irrespective of stage of development.

We estimate our model for all countries included in this study. The results are presented in Table 5. Our results show that both per capita income growth and financial development have negative sign which are statistically insignificant. Openness has negative and correct sign. The literacy rate has positive sign implying that as literacy rate increases, income inequality also increases. Population growth also has positive relation with income inequality, while unemployment rate with negative coefficient indicates that higher unemployment will result in to lower income inequality.

TABLE 5

Determinants of Income Inequality in Case of All Countries

Variable	Coefficient	Std. Error	t-Statistic
C	32.65391	4.024090	8.114608
FIN	–0.166838	0.618200	–0.269877
EDU	0.058911	0.037715	1.562017
OPP	–4.263600	1.933144	–2.205526
PGDP	–0.117380	0.356428	–0.329323
POPG	4.539327	0.822334	5.520051
UNEMP	–0.134839	0.103588	–1.301687

R-squared = 0.510573; F-statistic = 5.873302

We also include the inverse of squares of per capita income growth and financial development to test the inverted U-shaped hypothesis for both of variables. These results are presented in Table 6. The inverse of squares of

financial development is positive but insignificant which indicates the non-existence of inverted U-shaped relationship between financial development and income inequality. The inverse of square of per capita growth is significant and negative. It confirms the evidence of existence of inverted U-shaped relationship between income inequality and per capita income growth, while same does not hold for financial development.

TABLE 6

Determinants of Income Inequality in Case of All Countries and Testing of the Inverted U-Shape Hypothesis

Variable	Coefficient	Std. Error	t-Statistic
C	26.62326	4.055774	6.564286
FINSI	1.79E-07	1.55E-07	1.149016
INF	0.000194	0.000160	1.215155
EdU	0.100665	0.040020	2.515331
OPP	–3.401081	1.824124	–1.864500
PGDPSI	–0.001050	0.000355	–2.956228
POPG	5.188951	0.838536	6.188107

R-squared = 0.508238; F-statistic = 7.905118

V. CONCLUSIONS

This study attempts to analyze factors responsible for the differences in income distribution among the different groups of countries at different stages of economic development. It also tests the Kuznet's hypothesis that income inequality increases first with increase in income growth but after a certain level it decreases. We also test this hypothesis for financial development, i.e. the inequality first increases with financial development but then decreases.

Per capita growth raises income inequality in all the countries except in higher income countries. The results show that there is a weak evidence for the existence of inverted U-shaped hypothesis for income growth. The negative sign of the coefficient of financial development for all the countries

shows the negative relationship between financial development and income inequality irrespective of stage of economic development. This negates the inverted U-shaped relationship between income inequality and financial development. The results of the model which include inverse of squares of per capita income growth and financial development confirm the existence of inverted U-shaped relationship between per capita income growth and income inequality but no such relationship exists between financial development and income inequality.

Keeping in view the results of all models, it can be concluded that government consumptions, openness and literacy rate are the main variables which can be helpful in reducing income inequality in low income, lower middle income and upper middle income countries. It is, therefore, suggested in order to reduce the income inequality, the government of these countries should pay much emphasis to increase the literacy rate and devise policies for raising the openness and government consumptions.

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APPENDIX

Country List

LICs	No. of Obs.	LMICs	No. of Obs.	UMICs	No. of Obs.	HICs	No. of Obs.
Bangladesh	3	Belarus	2	Argentina	1	Australia	1
Cot de love	3	Belovia	2	Brazil	3	Canada	2
India	3	Bulgaria	2	Chile	3	Denmark	2
Niger	1	China	2	Costa Rica	3	Ireland	2
Pakistan	3	Columbia	3	Czech Rb	1	Italy	2
		Ecovador	2	Estonia	2	Japan	1
		Egypt	3	Hungry	2	Korea	3
		El Salvador	3	Jamaica	3	Netherlands	2
		Indonesia	2	Lithuania	2	New Zealand	1
		Macedonia	1	Malaysia	2	Portugal	2
		Morocco	2	Mexico	3	Singapore	2
		Peru	3	Poland	2	Slovenia	1
		Philippine	3	Slovak Rb	1	Sweden	2
		Sri Lanka	3	Trinidad	1	Switzerland	1
		Thailand	3	Venezuela	1	UK	2
						US	2
Total	13		36		30		28

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SAVINGS AND ECONOMIC GROWTH IN PAKISTAN: AN ISSUE OF CAUSALITY

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Abstract. The objective of the paper is to investigate causal relationship between savings and output in Pakistan by using quarterly data for the period of 1973:1 to 2003:4. The co-integration and the vector error correction techniques are used to explore causal relationship between savings and economic growth. The results suggest bi-directional or mutual long run relationship between savings and output level. However, there is unidirectional long run causality from public savings to output (GNP and GDP), and private savings to gross national product (GNP). The results also indicate that the speed of adjustment in case of savings is stronger than that of level of output. The overall long run results of the study favour the capital fundamentalist's point of view that savings precede the level of output in case of Pakistan. The short run mutual relationship exists between gross domestic product (GDP) and domestic savings. The results also indicate unidirectional short run causality from gross national product (GNP) to national and domestic savings; and from gross domestic product (GDP) to public savings. The short run causality runs only from national savings to gross domestic product (GDP). So overall short run results favour Keynesian point of view that savings depend upon level of output.

I. INTRODUCTION

The relationship between savings and economic growth is not only an important but also a controversial issue for both academicians and policy makers. Many internationally reputed economists have analyzed this phenomenon as cause and effect relationship. A group of economists favours

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capital fundamentalists point of view that savings cause growth but others are in favour of Keynesian theory that savings depend upon the level of output.

The importance of investigation of the causal relationship lies in the fact that it can be useful in isolating those variables which policy makers need to control in order to obtain the desired values of target variables such as economic growth. It might also be helpful in developing the econometric models and designing policies. If it turns out to be the case that savings causes economic growth, then it is necessary to enhance savings rate for achievement of high growth targets. If the results turn out the other way round, that high growth leads to more savings, then the Keynesian point of view is dominating: savings depends on income. Hence, in order to enhance growth, the policy prescriptions will be to emphasize the demand side of the economy. However, such a prescription according to Cohen (1997) is misleading and dangerous — that government needs not promote savings.

Solow (1956) suggested that savings affected the economic growth because higher savings led to capital accumulation, which in turn led to economic growth. Deaton (1995) argued that, "causation is important not just for understanding the process, but for the design of the policy." He provided support for the idea that savings was an important force for economic stability as well as growth. Hussein (1995) suggested that much of the differences in economic performance between Pakistan and the rapidly growing Southeast Asian countries, over the last two decades, were because of the low rates of savings and investment in Pakistan. Hence, it was emphasized that difference in the growth rate of developed and developing countries was primarily because of the difference in savings rates. Consequently, World Bank asked the developing countries to adopt policies which were conducive to savings in order to boost the economic growth (see Sinha and Sinha, 1998, p. 43). According to this view, savings is one of the key determinants of economic growth and it occurs before growth.

There is robust empirical evidence of positive correlation between savings and growth (see, for example, Modigliani 1970, 1990 and Madison, 1992). King and Levine (1994) showed the strong connection between the two variables by interpreting the evidence of a causal chain from savings to growth. These results did support 'capital fundamentalists'; according to which capital formation was the main driving force for high economic growth. According to *World Bank Policy Research Report* (1993), East Asian economies (Indonesia, Japan, Korea, Thailand, Taiwan and China) contradicted the above-mentioned results, *i.e.* income growth had been a

remarkably good predictor of increased savings, but savings had not been a good predictor of growth. Results were mixed for Hong Kong and Malaysia, and causation might run either way.

The World Bank report referred above made the economist to rethink about the relationship between savings and economic growth. With the work of Carroll and Weil (1994) something strange began to appear. Strong empirical evidence seemed to come out showing that higher savings followed higher growth. Jappelli and Pagano (1996) provided more evidence in favour of a positive causality from growth to savings, *i.e.* higher growth was necessary for higher savings. Hence, their results also contradicted the capital fundamentalist view on the aggregate level. The main findings of Blomstrom, Lipsey and Zejan (1996) were that gross domestic product (GDP) growth preceded capital formation. They did not find any evidence that capital formation preceded growth. Gavin et al. (1997) also raised doubts about the capital fundamentalist view that savings occurred before growth. They argued that "Higher growth rate precedes higher savings rather than the reverse" and that "the most powerful determinant of savings over the long run is economic growth" (p. 13). Sinha and Sinha (1998) suggested that the conventionally accepted view, *i.e.* higher savings rate caused higher economic growth, did not hold for Mexico, where the causality went in the opposite direction. Anderson (1999) conducted a study to investigate the causal relationship between real output and savings for Sweden, UK and USA. The results indicated mutual long run relationship between variables only for Sweden and UK. The result also indicated short run bidirectional causality for USA and unidirectional causality from saving to output for UK. No significant evidence of short run causality was found for Sweden. He concluded that the causal chain linking savings and output might differ across the countries. He also suggested that causality in the long run might go in different directions than causality associated with short-term disturbances. Saltz (1999) investigated the direction of causality between savings and growth rate of real GDP for 18 Latin American and newly industrialized countries for the period of 1960-1991. The results lent for greater support for the hypothesis that faster growth rate of real GDP caused higher growth rate of savings. Podrecca and Cormecci (1999) found that investment shares Granger caused growth rates and at the same time growth rates Granger caused investment shares. The Granger causality from investment shares to growth rates was found to be negative.

Vanhoudt (1998) suggested that recent Granger causality research on economic growth and accumulation rates which dismissed the validity of neoclassical growth models was based on a fallacy. He showed that the

finding of no or negative Granger causality was perfectly consistent with a neoclassical type of model. More precisely, such a model predicted negative Granger causality between medium run growth rates and investment shares, while there should not be Granger causality between these variables in the long run. Contrary to previous authors' intuition there was, therefore, no reason to reject the mechanical link between capital accumulation and growth, which was inherent to the neoclassical approach.

It is obvious from the above discussion that the causal relationship between savings and economic growth has been examined by various researchers for various countries but the issue of the direction of causation between savings and economic growth remained unresolved. No attempt has been made to investigate the causal relationship between savings and economic growth in Pakistan.[1] Some of the studies *inter alia*, Khan, Hasan and Malik (1992), Iqbal (1995), Hussein (1995); and Khan and Nasir (1998) have addressed the issue. Their findings were that the savings had long been regarded as a key factor in economic growth and the savings along with the incremental capital output ratio (ICOR) determined the growth rate of the economy. However these studies did not investigate causal relationship between savings and economic growth in Pakistan. In this paper we have made an attempt to investigate the direction of causation between of savings and output by using vector error correction model.

The rest of the paper is organized as follows: Section II consists of methodology employed in the paper. Nature and sources of data and various definitions of savings and level of output are explained in section III. Estimation procedures and empirical results are discussed in section IV. Finally, section V consists of conclusions and policy implications.

II. METHODOLOGY

To investigate the causal relationship between savings and economic growth, the following three-step methodology is applied:

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[1]We are thankful to the referee for pointing out a paper by Sinha (1998-99) on the subject. However our work is totally independent from his work. It is also notable that our work is a detailed analysis. He used aggregate annual data on GDP, total saving and private saving. Whereas we used quarterly data on GDP, GNP, domestic, national, public and private saving. In the paper he suggested to use disaggregated data on saving for further research. By chance we did that upto some extent in our paper. Our long run results don't support his findings.

UNIT ROOT TEST

Under this step the stationary properties of the variables are checked. A variable is said to be stationary if it's mean, variance and auto-covariance remains the same no matter at what point we measure them. The null hypothesis of non-stationarity is tested against alternative hypothesis of stationarity.

A number of tests are available in the literature to check the existence of the unit root problem both in the level of the variables as well as in their first difference, *i.e.* to determine the order of integration.[2] The Dickey Fuller (DF) test is applicable if error terms (U_t) are uncorrelated. In case the error terms (U_t) are correlated, DF test is useless. Augmented Dickey Fuller (ADF) test takes care of this problem by "augmenting" the equation(s) of DF test by adding the lagged values of the dependent variable(s). To test the unit root property of the variables, we employed Augmented Dickey Fuller test (ADF).[3] The equation for ADF test is as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + u_t \qquad (1)$$

In equation (1) 't' is time period, U_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ and so on.

To check the white noise property of residuals and to prove that the residuals are well behaved, we applied Lagrange multiplier (LM) and autoregressive conditional heteroskedasticity (ARCH) tests. The LM test is an alternative to the Q-statistics for testing serial correlation. The test belongs to the class of asymptotic (large sample) tests known as Lagrange multiplier (LM) test. Unlike the Durbin-Watson statistic for AR (1) errors, the LM test may be used to test for higher order ARMA errors, and is applicable whether or not there are lagged dependent variables. Therefore, LM test is recommended whenever we expect the possibility that our errors exhibit autocorrelation.

The autoregressive conditional heteroskedasticity (ARCH) test is a specification of heteroskedasticity. The ability to forecast financial time series, such as stock prices, inflation rates, foreign exchange rates, etc. varies

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[2]For detailed discussion of different tests to check the unit root problem and their robustness, please see Maddala and Kim (1998), Chapter 4.

[3]We also applied Phillip-Perron test. The results of both tests (ADF and Phillip-Perron) were same so we reported the results only of ADF test.

considerably from one time period to another. For some time periods the forecast errors are relatively small, for some time periods they are relatively large, and then they are small again for another time period. Since the behavior of forecast errors can be assumed to depend on the behavior of the (regression) disturbances u_t, one can make a case of autocorrelation in the variance of u_t. To capture this correlation, Engle developed the Autoregressive Conditional Heteroskedasticity (ARCH) Model. The key idea of ARCH is that the variance of u_t at time t ($= \delta^2_t$) depends on the size of the squared error term at time $(t - 1)$, that is on u^2_{t-1}.

CO-INTEGRATION

The concept of co-integration was introduced by Granger (1981) to protect the loss of long run information in the data due to differencing the series. If the linear combinations of variables of I (1) are I (0), then the variables are said to be co-integrated. Co-integration is the statistical implication of the existence of a long run relationship between economic variables. From statistical point of view, a long run relationship means that the variables move together over time so that short-term disturbances from the long-term trend will be corrected.

Co-integration procedure requires that a time series in the system to be non-stationary in their level. Similarly, it is imperative that all time series in the co-integrating equation have the same order of integration. To ascertain the long run relationship between savings and economic growth, we use vector autoregressive (VAR) model which was developed by Johanson (1988) and further extended by Johanson and Jusiluis (1990).[4]

To fix the idea, let s_t and y_t denote the logarithm of savings and of level of output respectively. Then let $Z_t = (s_t, y_t)$, $t = 1, \ldots, T$, define a vector of the time series which is generated by a p^{th} order vector autoregressive (VAR):

$$\begin{bmatrix} s_t \\ y_t \end{bmatrix} = \begin{bmatrix} a^1_{11} & a^1_{12} \\ a^1_{21} & a^1_{22} \end{bmatrix} \begin{bmatrix} s_{t-1} \\ y_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} a^p_{11} & a^p_{12} \\ a^p_{21} & a^p_{22} \end{bmatrix} \begin{bmatrix} s_{t-p} \\ y_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon 2t \end{bmatrix}$$

or $Z_t = A_1 Z_{t-1} + \ldots + A_p Z_{t-p} + \varepsilon_t$

or $Z_t = A(L)\, Z_{t-1} + \varepsilon_t$ where $A(L) = \sum_{i=1}^{p} A_i L^{i-1}$ (2)

[4]The second model of Johansen is estimated.

Where L is the lag operator and error term, ε_t, is assumed to be *iid* $(0, \sigma^2)$. Equivalently, this model can be rewritten as:

$$\Delta Z_t = B(L)\,\Delta Z_{t-1} - \Pi Z_{t-1} + \varepsilon_t \tag{3}$$

Where $\Delta = 1 - L$ is the first difference operator, and

$$B(L) = \sum_{i=1}^{p-1} B_i L^{i-1},\ B_i = -\sum_{j=i+1}^{p} A_j\ \ i = 1, \ldots, p-1, \quad \Pi = I - A,$$

The co-integration relationship is proportional to the column of β, and $\beta' Z_{t-1}$ is stationary variable. The vector α can be interpreted as a vector of adjustment coefficients, which measure how strongly the deviation from equilibrium feed back into the system. Testing for co-integration in the system (3) can be performed according to the Johansen (1988) approach where ΔZ_t and Z_{t-1} in (3) are first regressed on the other components of the VECM and the coefficients are then estimated using maximum likelihood subject to the constraint that $\Pi = \alpha\beta'$ for various assumptions of the column rank. Johansen procedure of co-integration provides two statistics. These include the value of the LR test based on the maximum eigenvalue of the stochastic matrix and the value of the LR test based on the trace of the stochastic matrix, where the testing is done sequentially so that the null of rank 0 is tested against the alternative of rank 1 first, and then rank 1 against rank 2.

VECM: A TEST OF CAUSALITY

In economics, systematic testing and determination of causal directions only became possible after an operational framework was developed by Granger (1969) and Sims (1972). Their approach is crucially based on the axiom that the past and present may cause the future but the future cannot cause the past (Granger, 1980). In econometrics the most widely used operational definition of causality is the Granger definition of causality, which is defined as follow:

"X is a Granger cause of Y (denoted as $X \rightarrow Y$), if present Y can be predicted with better accuracy by using past values of X rather than by not doing so, other information being identical" (Charemza and Deadman, 1992).

Since we are interested in testing the direction of causation between savings and growth, we can rewrite (3) in a more explicit form, where the assumption of co-integration has been added:

$$\begin{bmatrix}\Delta_{st}\\ \Delta_{yt}\end{bmatrix}=\begin{bmatrix}b_{11}^{1} & b_{12}^{1}\\ b_{21}^{1} & b_{22}^{1}\end{bmatrix}\begin{bmatrix}\Delta s_{t-1}\\ \Delta y_{t-1}\end{bmatrix}+.....+\begin{bmatrix}b_{11}^{p-1} & b_{12}^{p-1}\\ b_{21}^{p-1} & b_{22}^{p-1}\end{bmatrix}\begin{bmatrix}\Delta s_{t-p-1}\\ \Delta y_{t-p-1}\end{bmatrix}+\begin{bmatrix}\alpha_1\\ \alpha_2\end{bmatrix}[\beta_1\beta_2]\begin{bmatrix}s_{t-1}\\ y_{t-1}\end{bmatrix}+\begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\end{bmatrix}$$

The null hypotheses of non-causality of *s* on *y* can be expressed as restrictions on the parameters in the following way:

$$b_{21}^{1} = ... = b_{21}^{p-1} = 0, \alpha_2 = 0$$

The two parts of the test have been labeled as the tests of 'short-run' and 'long-run' Granger causality in the literature. Long run should not be interpreted in a temporal sense here; deviation from equilibrium is of course partially corrected between each period but in a "mechanical" sense. If there is unidirectional causality, say form savings to GDP, then in the short term deviations from the long-run equilibrium implied by the co-integrating relationship will feed back on changes in GDP in order to re-establish the long-term equilibrium. If GDP is driven directly by this equilibrium error, then it is responding to this feedback. If not, it is responding to short-term stochastic shock. The test of the elements in *B* (equation 3) gives an indication of the short-term causal effects, whereas significance of the relevant element in Π indicates long-term causal effects. (Masih and Masih, 1996).

III. NATURE AND SOURCES OF DATA

In this section the nature and sources of the data used in the analysis are discussed. Regarding the nature of the data, all the time series are quarterly observations of the variables for period 1973:1 to 2003:4. Different measures of savings and level of output are used.

For savings, we used national savings (NS) which is the sum of public and private savings. Private savings (PTS) consists of savings made by the household and the business organization. Public savings (PS) is the savings made by the government sector which is based on the budgetary condition of the government and it has negative relationship with the budget deficit. Domestic savings (DS) is obtained by subtracting net factor income form the national savings. Regarding the source of data, the annual data on all measures of savings are taken from annual reports of the State Bank of Pakistan. For level of output real gross domestic product (GDP) and gross national product (GNP) at the base year of 1980-81[5] are used. The annual

[5]Anderson (1999) has examined the causal relationship between savings and Economic growth by using level of output instead of growth rate of output.

data on GDP and GNP are taken from Pakistan Economic Survey. The quarterly data on the variables discussed above are not available. The annual data are first converted into quarterly data by using method given by Khan and Raza (1989). To avoid fluctuations in the data natural logarithms of all the variables are used. LNGDP denotes logarithm of GDP and so on. The prefix "D" with variables denotes the first difference of the variables.

IV. ESTIMATION AND INTERPRETATION OF RESULTS

The investigation of stationarity (or non-stationarity) of a time series is related to the test for unit root. Existence of unit root in a series denotes non-stationarity. The null hypothesis of non-stationarity of savings and output is tested against the alternative hypothesis of stationarity. In order to test stationarity of the variables in the data set, we employed ADF test. The results of this test are reported in the Table 1.

TABLE 1

Results of Unit Root Test

ADF Test in Levels			ADF Test in 1st Differences		
Regression with an intercept and trend			Regression with an intercept		
Variables	Lags	Calculated ADF value	Variables	Lags	Calculated ADF value
LNGDP	3	0.192	DLNGDP	3	–3.74
LNGNP	3	–0.909	DLNGNP	3	–4.06
LNDS	3	–3.265	DLNDS	3	–7.74
LNNS	4	–3.084	DLNNS	4	–7.32
LNPS	4	–2.97	DLNPS	3	–12.32
LNPTS	3	–3.237	DLNPTS	3	–8.54

NOTE: In case of levels of the variables critical value at 5% is –3.4 and all the calculated values are significant at 5% significance level. In case of first differences of the variables critical value at 5% is –2.88 and all the calculated values are significant at 5% significance level. This critical value is taken from McKinnon (1991). Lags are chosen according to Akaik Information Criterion and Schwarz Bayesian Criterion.

Table 1 shows that in case of levels of the series, the null hypothesis of non-stationarity cannot be rejected for any of the series. Therefore, all series are non-stationary at levels. Application of the same test at first differences to determine the order of integration; the critical values are less (in absolute terms) than the calculated values of the test statistics for all series. This shows that all the series are integrated of order one, *i.e.* I (1), and become stationary after differencing once. It is also to be noted that at first differences of the variables the trend becomes insignificant so the ADF test is used with an intercept only.

Residuals are also proved to be white noise at these lags by employing serial correlation LM and ARCH tests. The results of LM and ARCH tests are given in Tables 2 and 3.

TABLE 2

The Results of LM and ARCH Tests in Level

VARIABLES	LAGS	LM TEST		ARCH TEST	
		χ^2	Prob.	χ^2	Prob.
LNGDP	3	107.06	0.29	49.86	0.47
LNGNP	3	104.12	0.36	53.48	0.34
LNDS	3	98.26	0.53	53.47	0.34
LNNS	4	112.62	0.18	2.98	0.99
LNPS	4	105.03	0.34	50.54	0.45
LNPTS	3	103.43	0.87	38.83	0.87

Table 2 shows that at these lags the residual terms are pure white noise, *i.e.* they are well behaved and the null hypothesis of no autocorrelation and no heteroskedasticity among residuals is accepted in both Lagrange Multiplier Test and Auto Regression Conditional Heteroskedasticity as shown by the insignificant χ^2 values.

The results in Table 3 indicate that residuals are also well behaved at first differences of the variables. It is indicated by the insignificant χ^2 values.

The null hypothesis of no autocorrelation in case of LM test and null hypothesis of no heteroskedasticity in case of ARCH test are accepted.

TABLE 3

The Results of LM and ARCH Tests with first Difference

VARIABLES	LAGS	LM TEST		ARCH TEST	
		χ^2	Prob.	χ^2	Prob.
DLNGDP	3	107.88	0.40	43.36	0.73
DLNGNP	3	97.79	0.54	54.62	0.30
DLNDS	3	97.36	0.55	60.12	0.15
DLNNS	4	89.51	0.76	54.14	0.31
DLNPS	3	104.12	0.36	49.84	0.47
DLNPTS	3	77.78	0.95	41.87	0.78

CO-INTEGRATION

Co-integration relationship is investigated by using Johansen technique. We calculate the trace statistics and the maximum eigenvalue statistics. The null hypothesis of no co-integration vector is tested against the alternative hypothesis of one co-integrating vector.

Trace test is used to check whether there exists co-integration between variables or not. The results of the test are reported in Table 4. The results indicate that co-integration relationship between savings and level of output exist. To find out the exact number of co-integrating vectors we use maximum eigenvalue test. The results of λ max test are also given in Table 4.

The results of the Johansen test show that the null hypothesis of no co-integration is rejected at 5% significance level in all of the cases. However, the null hypothesis of one co-integration cannot be rejected for all of the cases. The existence of co-integration relationship between savings and level of output suggests that there is long run relationship between the two series and the residuals obtained from the co-integrating vectors are stationary at their levels, *i.e.* I (0).

TABLE 4

Results of Johansen Co-integration Test

Variables	Lags	λ trace test			λ max test		
		H_0	H_1	Trace Statistics	H_0	H_1	Maximum Eigen values
LNGDP LNDS	1 3	r = 0 r ≤ 1	r > 0 r > 1	28.86** 6.48*	r = 0 r = 1	r = 1 r = 2	22.32** 6.48*
LNGDP LNNS	1 2	r = 0 r ≤ 1	r > 0 r > 1	31.532** 4.307*	r = 0 r = 1	r = 1 r = 2	27.225** 4.307*
LNGDP LNPS	1 2	r =0 r ≤ 1	r > 0 r > 1	32.428** 5.324*	r = 0 r = 1	r = 1 r = 2	27.104** 5.324*
LNGDP LNPTS	1 2	r = 0 r ≤ 1	r > 0 r > 1	31.339** 3.63*	r = 0 r = 1	r = 1 r = 2	27.709** 3.63*
LNGNP LNDS	1 6	r = 0 r ≤ 1	r > 0 r > 1	25.48** 4.53*	r = 0 r = 1	r = 1 r = 2	20.95** 4.53*
LNGNP LNNS	1 3	r = 0 r ≤ 1	r > 0 r > 1	31.56** 4.44*	r = 0 r = 1	r = 1 r = 2	27.12** 4.44*
LNGNP LNPS	1 3	r = 0 r ≤ 1	r > 0 r > 1	40.28** 5.88*	r = 0 r = 1	r = 1 r = 2	34.32** 5.88*
LNGNP LNPTS	1 2	r = 0 r ≤ 1	r > 0 r > 1	33.57** 4.67*	r = 0 r = 1	r = 1 r = 2	27.225** 4.67*

NOTE: In case of λ trace test the critical values for the hypothesis r = 0 at 5% and 1% significance levels are 15.19 and 6.936 respectively.

**indicates the rejection of the null hypothesis at 5% significance level.

*indicates acceptance of null hypothesis at 1% significance level.

In case of λ max test the critical values for the hypothesis r = 0 at 5% and 1% significance levels are 14.036 and 6.936 respectively.

**indicates rejection of null hypothesis at 5% significance level.

*indicates acceptance of null hypothesis at 1% significance level

Lags are chosen according to Likelihood Ratio Test.

VECTOR ERROR CORRECTION: A TEST OF CAUSALITY

Vector error correction model (VECM) is estimated to examine the causal relationship between savings and level of output in Pakistan. The long run causality is checked by using the t-ratios of the error correction terms. They are basically the coefficient of speed of adjustment which shows how

TABLE 5

Long Run Causality Results

REGRESSIONS	'*t*' VALUES OF α
DLNDS DLNGDP	3.67*
DLNGDP DLNDS	2.10**
DLNNS DLNGDP	3.79*
DLNGDP DLNNS	–2.84*
DLNPS DLNGDP	–3.30*
DLNGDP DLNPS	1.02
DLNPTS DLNGDP	1.75***
DLNGDP DLNPTS	–2.61*
DLNDS DLNGNP	3.71*
DLNGNP DLNDS	2.13**
DLNNS DLNGNP	4.28*
DLNGNP DLNNS	–1.99**
DLNPS DLNGNP	2.97*
DLNGNP DLNPS	–0.99
DLNPTS DLNGNP	2.64*
DLNGNP DLNPTS	–1.15

NOTE: *indicates significant values at 1% significance level.

**indicates significant values at 2.5% significance level.

***indicates significant values at 5% significance level.

strongly the deviation from equilibrium feed back into the system. The short run causality is determined by the t-values of the coefficients of the lagged terms of independent variables. This procedure is particularly attractive over the standard VAR because it permits temporary causality to emerge from (1) the lagged coefficients of the explanatory differenced variable and (2) the coefficient of the error correction term. In addition the VECM allows causality to emerge even if the coefficients of lagged differences of the explanatory variables are not significant. It must be pointed out that the standard Granger causality test omits the additional channel of influence, *i.e.* the significance of the coefficient of error correction term.

TABLE 6

Short Run Causality Results

Regressions	Lags	'*t*' values of coefficients of lagged independent variables
DLNNS DLNGDP	1 2	–1.83*** (1)
DLNGDP DLNPTS	1 4	–1.97*** (4)
DLNGNP DLNNS	1 2	1.56*** (1)
DLNDS DLNGDP	1 4	–1.48**** (4)
DLNGDP DLNDS	1 4	–2.27* (4)
DLNGNP DLNDS	1 4	–4.106* (4)

NOTE: Figures in brackets indicate lag at which 't' values are significant. The regressions having insignificant results are not reported.

*indicates significant values at 1% significance level.

***indicates significant values at 5% significance level.

****indicates significant values at 10% significance level.

The results of long run Granger causality are reported in Table 5. The results indicate that there is mutual long run causality between savings and level of output because of the significant '*t*' values of the speed of adjustment coefficient. There is unidirectional long run causality from public savings to output (GNP and GDP) and from private savings to only GNP. It is also to be noted that savings adjust strongly from the disequilibria into

equilibrium system than the level of output. It means speed of adjustment in case of savings is stronger than that of level of output.

The short run causality between the variables is checked by the t-values of the coefficient of lagged terms of independent variables in VECM. The results of short run causality are reported in Table 6. Akaike information criterion (AIC) and Schwartz Bayesian information criterion (SBIC) are used to choose optimum lag length of the variables included in the VECM. There is mutual short run causality between GDP and domestic savings. The results also indicate the presence of short run unidirectional causality from output (GNP) to national and domestic savings, GDP to private savings. The short run causality runs only from national savings to GDP. No evidence of short run causality is found in other cases. It shows that if simple Granger test is used to check the causality, it would not extend any support to causal relationship between savings and level of output. However, the use of vector error correction technique proves that both these variables cause each other in the long run through the error correction term.

V. CONCLUSIONS AND POLICY IMPLICATIONS

The objective of the paper is to investigate causal relationship between savings and output in Pakistan. The co-integration and vector error correction techniques are used to explore direction of causality for the period 1973:1-2003:4. The results of ADF test show that all measures of savings and level of output are integrated of order one. It means that these variables are stationary at their first differences. Once it is found that all the variables used in the analysis are integrated of the same order, we apply Johansen's co-integration test to check whether the variables have long run relationship. The results of the co-integration test show that there is long run equilibrium relationship between different measures of savings and level of output. The residuals obtained from these co-integrating vectors are also stationary at their levels.

The results of the VECM suggest a long run bi-directional relationship between different measures of savings and level of output. However there is unidirectional long run causality from public savings to both measures of output (GNP and GDP) and from private savings to GNP only. The speed of adjustment in case of savings is stronger than that of level of output. There is mutual short run causality between gross domestic product (GDP) and domestic savings. The unidirectional short run causality runs from output (GNP) to national and domestic savings and from GDP to private savings. Only the national savings causes the GDP in the short run.

The results of the paper are mixed for both long run and short run causality. In case of long run there is mutual causality between savings and level of output and if there is any unidirectional causality, it runs from savings to level of output and not the other way. So, in the long run our results favour capital fundamental's point of view that savings causes economic growth. There is mutual short run causality between domestic savings and GDP. The results also suggest unidirectional short run causality from level of output (GNP) to national and domestic savings. Unidirectional short run causality runs only from national savings to GDP. So, overall short run results favour Keynesian point of view, *i.e.* savings depends upon level of income. Our results are in line with conclusions of Anderson (1999) that causality in the long run might go in different directions than causality associated with short-term disturbances. Deaton (1995) pointed out that "the causation is important, not just for understanding the process, but for the designing of policy. If savings is the mover of growth then policies should be implemented which give savings incentive, such as tax breaks, compulsory savings in employee provident funds. The results imply that policies should be implemented which are in favour of savings. The savings and then economic growth can be promoted by implementing following policies:

1. Creation of stable and predictable economic environment that rewards savers for thrift and reduces the fear that inflation or a collapsing of financial system will lead to expropriation of their savings. This implies stabilizing inflation, strengthening domestic financial institutions, and increasing the role of market signals in the allocation of savings and investment, *i.e.* the elimination of financial repression.

2. The government has been a major dis-saver therefore it is necessary to reverse this habit and to render public savings positive. This requires strong improvement on the fiscal balance, particularly the revenue balance. Another promising way to increase national savings is to concentrate on household savings which accounts for roughly three-fourth of national savings. Several long term savings instruments may be developed to increase household savings. There is also need to expand network of National Savings Schemes, microfinance institutions, banks and postal savings to far flung areas of the country. There is also need to launch a comprehensive campaign to explain the value of savings to Pakistanis. Macroeconomic stability combined with solid prudential regulations of financial institutions may create an environment in which would raise savings.

3. The Central Directorate of National Savings needs to be converted into an autonomous body which would improve the performance of the savings centers. A system of paying commission to those centers who mobilizes more savings may also enhance savings in the country.

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ECONOMIC EVALUATION OF FOREIGN DIRECT INVESTMENT IN PAKISTAN

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Abstract. Foreign Direct Investment (FDI) in Pakistan is one of the major external sources of funding to meet obligations of resources gap and goal achievement. FDI has played a vital role in the economic growth of Pakistan. FDI contributed significantly in the human resources development, capital formation, and organizational and managerial skills of the people in the country. Total foreign investment was $ 6.0 billion, of which FDI amounted to $ 4.16 billion in the year 2007. The present research study empirically analyzed the impact of FDI on Pakistani imports and exports through time series data. The study applied the Unit Roots test to check the stationarity of the data series used in the analysis. Cointegration technique was used to analyze the long run relationship among the variables. Error Correction Model was used for further analysis.

The results of the import model showed that FDI positively impacted real demand for imports in the short run and in the long run. In case of one percent increase in FDI; real demand for import would increase by 0.08 percent in the short-run and 0.52 in the long run. The results of export model showed that FDI has negative relation with real exports in the short-run and positive relation in the long run. The export model estimations indicated that with one percent increase in FDI, real export decreased by –0.08 percent in the short-run and increased by 1.62 percent in the long run.

I. INTRODUCTION

In recent decades under the changing modes of international transactions and cross-border mobilization of production factors, foreign direct investment

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(FDI) attracted great attention not only in developing countries but also in developed countries. The open FDI regime forced the host countries to adopt greater deregulation policies and reliance on market forces in their economies. Most developing countries such as Pakistan now considered FDI as the major external source of funding to meet obligations of resources gap and economic growth, however it is difficult to measure economic effects with precision. Nevertheless, various empirical studies showed a significant role of inward FDI in economic growth of the developing countries, through its contribution in human resources, capital formation, enhancing of organizational and managerial skills, and transfer of technology, promoting exports and imports and the network effect of marketing. The other positive spillover effect was that the presence of foreign firm helps expand infrastructure facilities, which makes it easier and profitable for local firms to crowd-in (Lemi, 2004).

The negative impacts occur with competition over scarce resources and limited skilled manpower, due to strategic motives by the affiliates of Multinational Corporations (MNCs) or the high technological gap between local and foreign firms. There were also other costs associated with inflow of FDI such as restrictive business practices by foreign firms, profit repatriation and forgone tax in the case of tax holidays. The net welfare effects also differed by the nature of FDI, motives behind internal transactions, and host countries government policies.

Many factors made Pakistan an attractive place for foreign investments. Firstly, the Pakistanis economy showed responsiveness and potential capacity to meet exogenous shocks and minimize risks in response to various major regional and global events, for instance, the nuclear blast (1998), the bombing against French technicians in Karachi (2001); 9/11, 2001 which placed Pakistan in the frontline again and aid from Washington began to flow once again. The subsequent events included: Afghanistan war; the attack on India's Parliament (2001) that led to mobilization of Indian troops, the 2003 war in Iraq, Karachi Stock Exchange (KSE) crisis and severe earthquake (2005). Thus, foreign investors were assured that they could carry out business in a stable and certain environment.

Secondly, Pakistan has a population of more than 150 million (IFS, 2005) which provides a large market for consumer goods, a growing middle class with adequate purchasing power, and provision of low-cost labour, which reduces the cost of production and its strategic geographical location in Central and South East Asia.

Thirdly, Pakistan has a world-class physical infrastructure, which was necessary for investment. The country inherited strong institutions from the British, and provided adequate communication infrastructure for foreign investors.

Finally, there was also a strategic consideration for increasing FDI in Pakistan having implications for global security (Hussain, 2003).

Pakistan also undertook wide-ranging structural reforms in various sectors of the economy and pursued sound macroeconomic policies for the last seven years. Pakistan has now emerged as a favorite destination for foreign investors, both direct and portfolio investment. Total foreign investment during the (2006-2007) increased to $ 6.0 billion, which was almost 48 percent higher than last year in the same period. Within total foreign investment, foreign direct investment (FDI) amounted to $ 4.16 billion, which was 37 percent higher than last year (GOP, 2006-07). Important areas of FDI were: telecom, energy (oil and gas, power, petroleum refineries), banking and finance, and food and beverages. These four groups accounted for over 80 percent of FDI inflows (GOP, 2006-07). Other areas, for instance, textile, chemicals and petro-chemicals, automobiles, construction and trade, were also attracting FDI. Nearly 78 percent of FDI came from five countries. Pakistan's equity market was also attracting huge portfolio investment and has created brisk activity in stock markets (as Karachi Stock Exchange (KSE) of Pakistan). The magnitude of the foreign investment reflected the confidence of global investors on the current and future prospects of Pakistan's economy (GOP, 2006-07). The target of Exports in 2006-07 was at $ 18.6 billion or 12.9 percent higher than last year.

During the current fiscal year, exports increased only by 3.4 percent, rising from $ 13.46 billion to $ 13.9 billion. Pakistan's exports were mainly consisted of few items namely; cotton, leather, rice, synthetic textiles and sports goods. Imports target was set to decline by 2.1 percent in 2006-07 to $ 28.0 billion from last year's level of $ 28.6 billion (GOP, 2006-07).

The FDI *inter alia* was constrained by a number of factors namely, political instability, law and order, economic environment and no proper infrastructure, the instability in stock markets and regulatory regime. Nevertheless, FDI and foreign remittances provided a strong base to improve the economic situation of the country. The study envisaged a significant addition to the empirical estimation of the impact of foreign direct investment on Pakistan economy. The objective of this paper is to analyze the impact FDI on imports, exports and identify the constraints confronting

foreign investment. The results of the study provide the policy makers with a firm basis to formulate appropriate programs leading to the development of the Pakistan economy.

II. DATA AND METHODOLOGY

Time series data is used to find the impacts of foreign direct investment on Pakistan's imports and exports for the period of 1973-2004 in this study. The data are taken from international finance statistics (IFS) Pakistan data (2005) and Handbook of Statistics on Pakistan Economy (2005) of State Bank of Pakistan (SBP). The included variables in this research analysis are: real Gross Domestic Product, GDP deflator, volume of exports, unit value of export, volume of imports, unit value of import, volume of foreign direct investment (FDI) as a percentage of GDP. The dummy variable D_1 is used for military rule and democracy. The D_1 is equal to one for military rule and zero for democracy. The variables are described in Table 1A in Appendix.

The time series data often show the property of non-stationarity in levels and the resulted estimates usually provide spurious results. Thus, the first step in any time series empirical analysis was to test for presence of unit roots to remove the problem of inaccurate estimates. The other important step was to check the order of integration of each variable in a data series in the model to establish whether the data under hand suffer unit root and how many times it needed to be differenced to gain stationarity.

Firstly, Augmented Dickey-Fuller (ADF) test is applied for unit roots to find out that the variables included are integrated of the same order. Then, Johansen-Juselius (1990) test for Cointegration is employed followed by error correction model (ECM). The variables are integrated of the same order. The unit root test showed that variables are integrated of order one or I (1). A few of the time series such as Lnpmpg and Lnrem showed ambiguity in stationarity, *i.e.* I (0) which implied that these series are unable to explain the long run relationships between I (1) variables, but are allowed to enter as un-restricted VAR as exogenous variables. The results of Augmented Dickey-Fuller (ADF) test are obtained in the Tables 2A and 3A. An ADF test indicated the existence of unit roots in levels of all variables ($p = 0.05$) with and without trend.

The functional equations specified to study the impact of FDI are based on Khan and Kim (1999) model. The linear formulation of import and export are given as under:

Real Demand for Import Model

$$\text{Ln } M = b_0 + b_1 \text{ Ln } y + b_2 \text{ Ln } (Pm / Pg) + b_3 \text{ Ln } FDI\ (-1) + b_4 \text{ Ln } rem + D1 + e_{mt} \quad (1)$$

Real Export Model

$$\text{Ln } X = b_0 + b_1 \text{ Ln } y + b_2 \text{ Ln } (Px / Pg) + b_3 \text{ Ln } FDI + b_4 \text{ Ln } rem + D1 + e_{xt} \quad (2)$$

Here e_{mt} and e_{xt} in equations (1) and (2) were the stochastic error terms encompassing the left over effects in real import model and real exports model respectively. These are considered as distributed independently and normally with zero mean and constant variance.

Shah and Ahmad (2003), Ahmad *et al.* (2003), Afzal (2004), Aqeel and Nishat (2004), and many other studies have applied Unit roots (ADF) test and Cointegration techniques to analyze the determinants of FDI, to watch the impact of FDI on growth and to observe the relation of Exports and imports with FDI. In this study, two techniques were used to test cointegration. These techniques were Augmented Dickey-Fuller (ADF) residual-based test technique suggested by Engle and Granger (1987) and the Johansen's Full Information Maximum Likelihood (FIML) approach proposed by Johansen (1988) and Johansen and Juselius (1990).

III. RESULTS AND DISCUSSION

The variables used in the research are found cointegrated, therefore, their long run relationship are estimated via ordinary least square method (OLS) and Vector Error Correction Model (VECM) is used for the estimation of short run adjustment. Shah and Ahmad (2003), Aqeel and Nishat (2004) and many other studies have applied Error-Correction techniques to observe the relationship between FDI and other variables.

Firstly, the cointegration among the variables used in the real demand for import model and real export model was assessed on residuals test basis. The equations (1) and (2) are tested by OLS method to apply the residual test. ADF-test was conducted upon the residual e_{mt} and e_{xt} obtained from equations (1) and (2). The residual/error term 'e_{mt}' was generated from the estimated import model and it was found that error term was I (0) as e_{mt} without trend was ($-3.42 < -2.97$), with trend it was ($-3.345 < -3.567$), It showed that the variables used in import model were cointegrated. The residual/error term 'e_{xt}' was obtained from the estimated real export model and it was found that error term were I (0) as e_{xt} without was trend ($-5.298 < -2.97$), with trend it was ($-5.203 < -3.567$). It showed that the variables used

in export model were cointegrated. The residual e_{mt} and e_{xt} were stationary. Therefore, residuals in these models were integrated of order zero, *i.e.* I (0) and all the other variables used in the models were integrated of order one, *i.e.* I (1). Therefore, cointegration or existence of a long-run relationship among the variables in equations (1) and (2) was found.

Secondly, the Johansen's technique, that permitted to check all possible cointegrating vectors existing among the variables, was also applied in both models. Thus, the order of Vector Auto Regression (VAR) model was determined before estimating the cointegration tests. It was important to specify the relevant order of lags (p) of VAR model. Given the time series nature of the data, p = 1 seemed a reasonable choice (Pesaran and Pesaran, 1997). To identify the order of lags of unrestricted (VAR) for VECM modeling Johansen (1992) procedure was used.

Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) were also described in the Table 4A where p = 4 was selected as the order of VAR on the basis of SBC to avoid over-parameterization of a time series. In order to test the presence of cointegration and find the number of cointegrating vectors among the series of real import model, the unrestricted intercept and no trend model was used in the Johansen Cointegration model. The results of the Cointegration with unrestricted intercepts and no trends in the VAR based on Maximal Eigen Value of the Stochastic were given in Table 5A. One cointegrating vector was selected on the basis of the Eigen Value Test. Therefore, it is concluded that the included variables in the real demand for import model were cointegrated.

Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) were also described in the Table 6A in which p = 3 was selected as the order of VAR on the basis of SBC to avoid over-parameterization of a time series.

The results of the Cointegration with unrestricted intercepts and no trends in the VAR based on Maximal Eigen Value of the Stochastic were given in Table 7A. One cointegrating vector was selected on the basis of the Eigen Value Test. Therefore, it is concluded that the variables in the real export model were cointegrated.

ECM FOR REAL DEMAND FOR IMPORT

The Johansen normalized estimates for the Real Demand for Import were shown in Table 1. The coefficients showed estimates of long-run elasticities of Real Demand for Import with respect to FDI and GDP (*y*), relative prices of import and foreign remittances.

TABLE 1

Johansen Normalized Estimates for the Real Demand for Import

Real Demand for Import equation
Lnm = –2.893 Lny + 3.109 Lnpm/pg + 0.522 LnFDI + 0.177 Lnrem + 8.468

The ECMs for the real demand for import in Table 1 were:

Ecm1 = 0.14087*LNM + 0.58271*LNY + 0.89384*LNPMPG – 0.52006*LNFDI – 0.071472*LNREM – 0.078103*D1 – 2.9005

Ecm2 = 0.73272*LNM – 2.0701*LNY + 3.0239* LNPMPG + 0.40736*LNFDI + 0.064464*LNREM + 0.31941*D1 + 5.9977

The results in Table 2 demonstrated that real demand for import was dependent on the GDP, relative prices of import, FDI and foreign remittances. The short-run elasticity of imports for FDI was significant ($p = 0.05$) and showed expected sign. The magnitude of the long-run import elasticity was high with expected sign but was not significant. The results showed that one percent increase in FDI, real demand for import would increase by 0.078 percent in the short-run and 0.52 percent in the long run. The elasticities of imports for real GDP, foreign remittances and dummy were significant ($p = 0.1$) in the short-run. The magnitude of elasticities of imports was 1.291 for real GDP, 0.087 for foreign remittances and 0.06 for dummy. The result of import model for relative import prices was not significant having elasticity (–0.166). The coefficients of lagged FDI were 0.078 in the short run and 0.52 in the long run in the import model. These results were comparable with Khan and Kim (1999) where the authors found that the coefficient of lagged FDI in the long run was 0.18 in the import model. The coefficients of real GDP were 1.291 and –2.893 in the short run and the long run respectively. Further these results theoretically indicated that a lion's share of FDI was import-oriented and short lived, *i.e.* FDI included telecom, energy, banking and finance, and food and beverages. These four groups accounted for over 80 percent of FDI inflows (GOP, 2006-07), as the projects were completed, the imports reduced and in the long run import-substitution strategy seems appropriate. GDP results also supported our arguments. Increased foreign remittances inspired people to spend lavishly on imported items but this trend reduced in the long run, also increased

Aggregate Demand caused more imports. The coefficient of the error correction term (EC) showed positive sign and indicated the adjustment toward long run equilibrium. The coefficient of 0.025 showed that the deviation of real demand for import from the long run equilibrium level was corrected by about 2.5 percent in the current period. The rationale for this slow rate adjustment was perhaps due to various constraints, *i.e.* political stability, law and order, economic environment and poor infrastructure and regulatory regime.

TABLE 2

The Error Correction Model Estimates for Real Demand for Import

Regressors	Short-Run	Long-Run
Constant		8.468 (0.529)
ΔLNM1	–0.075 (–0.408)	1.000
ΔLNY1	1.291 (1.54)*	–2.893 (0.851)
ΔLNPMPG1	–0.166 (–0.94)	3.109 (0.594)
ΔLNFDI1	0.078 (2.04)**	0.522 (0.971)
ΔLNREM1	0.087 (1.81)*	0.177 (0.364)
ΔD11	0.064 (1.50)*	0.603 (0.529)
Ecm1 (–1)	0.025 (0.38)	
Ecm2 (–1)	–0.047 (–0.71)	
R-Squared	0.37965	
SE of Regression	0.066541	
Residual Sum of Squares	0.097409	
DW-statistic	2.2715	

NOTE: ** and * indicate significant at the 5 percent and 10 percent level of significance, respectively.

Δ indicates the first difference of the variable used.

The results of generalized Impulse Response Functions (IRF) for the real demand for import model were given in Table 3 and Figure 1. The results showed that one standard error shock to real demand for import caused initial response of 10 percent after second year till it returns to long run equilibrium but slightly increasing trend in horizon, gained again equilibrium. One standard error shock to the real demand for import showed an initial response of 1 percent in GDP (Y) that continued slightly rising to 0.02 percent. In the same way, one standard error shock to the real demand for imports regarding relative prices of import attained long run equilibrium after third year, Foreign Direct Investment (FDI) received long run equilibrium after first year, foreign remittances got equilibrium after third year but trend and furthermore binary variable sets long run equilibrium after third year.

TABLE 3

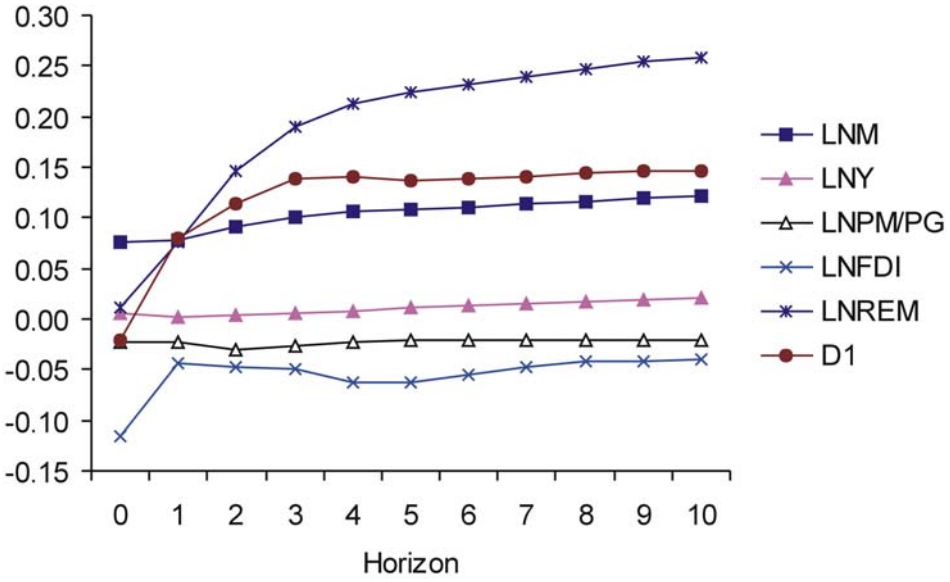
Generalized Impulse Response(s) to one SE shock in the equation for LNM

Horizon	LNM	LNY	LNPM/PG	LNFDI	LNREM	D1
0	0.0756	0.0065	–0.0220	–0.1167	0.0112	–0.0201
1	0.0777	0.0027	–0.0224	–0.0440	0.0751	0.0790
2	0.0908	0.0036	–0.0303	–0.0478	0.1467	0.1135
3	0.1007	0.0057	–0.0273	–0.0496	0.1893	0.1391
4	0.1065	0.0081	–0.0234	–0.0634	0.2136	0.1406
5	0.1088	0.0105	–0.0210	–0.0621	0.2243	0.1369
6	0.1110	0.0126	–0.0207	–0.0544	0.2311	0.1377
7	0.1135	0.0148	–0.0216	–0.0470	0.2396	0.1414
8	0.1165	0.0171	–0.0218	–0.0427	0.2474	0.1451
9	0.1192	0.0194	–0.0214	–0.0412	0.2535	0.1462
10	0.1213	0.0217	–0.0209	–0.0394	0.2575	0.1456

The results of impulse response function for real demand for import model were given in the following Figure 1.

FIGURE 1

Generalized Impulse Response(s) to One SE Shock in the Equation for LNM



ECM FOR REAL EXPORTS

The Johansen normalized results for the Real export were illustrated in Table 4. The coefficients represent estimates of long-run elasticities of Real export with respect to FDI and real GDP, relative prices of export and foreign remittances and dummy.

TABLE 4

Johansen Normalized Estimates for the Real Export

Real Export equation
Lnx = –8.381 Lny – 12.247 Lnpx/pg + 1.623 LnFDI + 0.788 Lnrem + 36.027

Ecm1 = 0.24002*LNX + 0.70908*LNY – 1.2853*LNPXPG – 0.64272*LNFDI – 0.092138*LNREM – 0.16370*D_1 – 3.4633

Ecm2 = –0.77779*LNX + 1.8085*LNY + 1.2043*LNPXPG – 0.27287*LNFDI – 0.14263*LNREM – 0.066549*D_1 – 4.5531

The results in Table 5 showed that real export was dependent on the GDP, relative prices of export, FDI and foreign remittances. The short-run elasticity of export for FDI was not significant with negative sign. The magnitude of the long-run export elasticity was high with expected sign but was not significant. The results showed that one percent increase in FDI, real export decreased by –0.079 percent in the short run and increases by 1.623 percent in the long run. The elasticities of export for real GDP, foreign remittances and dummy were shown as 2.079 and –8.381 for real GDP, 0.013 and 0.788 for foreign remittances and 0.071 and 1.421 for dummy in the short-run and long run respectively.

TABLE 5

The Error Correction Model Estimates for Real Exports, Pakistan

Regressors	Short-Run	Long-Run
Constant		36.027 (0.217)
ΔLNX1	–0.463 (–2.36)*	1.000
ΔLNY1	2.079 (–0.23)	–8.381 (0.444)
ΔLNPX/PG1	–0.105 (–0.94)	–12.247 (0.226)
ΔLNFDI1	–0.079 (–0.82)	1.623 (0.195)
ΔLNREM1	0.013 (0.09)	0.788 (0.200)
ΔD11	0.071 (0.69)	1.421 (0.208)
Ecm1 (–1)	–0.008 (–0.05)	
Ecm2 (–1)	0.018 (0.11)	
R-Squared	0.30	
SE of Regression	0.166	
DW-statistic	2.141	

NOTE: * and ** indicate significant at the 1 percent and 5 percent level of significance, respectively.

Δ indicates the first difference of the variable used

The coefficient of FDI was 1.623 in the long run in the export model. This result is consistent with Khan and Kim (1999) where the authors found that the coefficient of FDI in the long run was 0.07 in the export model. Coefficients have same sign with different magnitudes due to different duration of data periods.

The big share of FDI came to Pakistan was not export-oriented (Important areas of FDI were: telecom, energy, banking and finance, and food (GOP, 2006-07), and most part of the investment was in private sector to capture the domestic market in Pakistan. Increased GDP and foreign remittances were used for unproductive expenditures, *i.e.* construction of bungalows, luxury automobiles, and conspicuous consumption. Therefore, results supported arguments taken in the analysis. The coefficient of –0.008 showed that the deviation of real export from the long run equilibrium level is corrected by about 0.08 percent in the current period. The rationale for this slow rate adjustment was perhaps due to various constraints, *i.e.* political instability, law and order situation, economic environment and poor infrastructure, regulatory regime and continuous inflationary pressure.

The results of generalized impulse response functions for the real export model were shown in Table 6 and Figure 2. The results showed that one standard error shock to real export caused initial response by decreasing 18 percent in the third year again rising to 19 percent One standard error shock to the real export revealed an initial response of GDP that continuously increasing trend (a minor increasing occurs). Similarly, one standard error shock to the real export regarding relative prices of export represented fluctuated long run equilibrium after second year. Foreign Direct Investment (FDI) showed slight increasing long run equilibrium after second year, foreign remittances also behave in same way as FDI while dummy showed long run equilibrium after third year.

TABLE 6

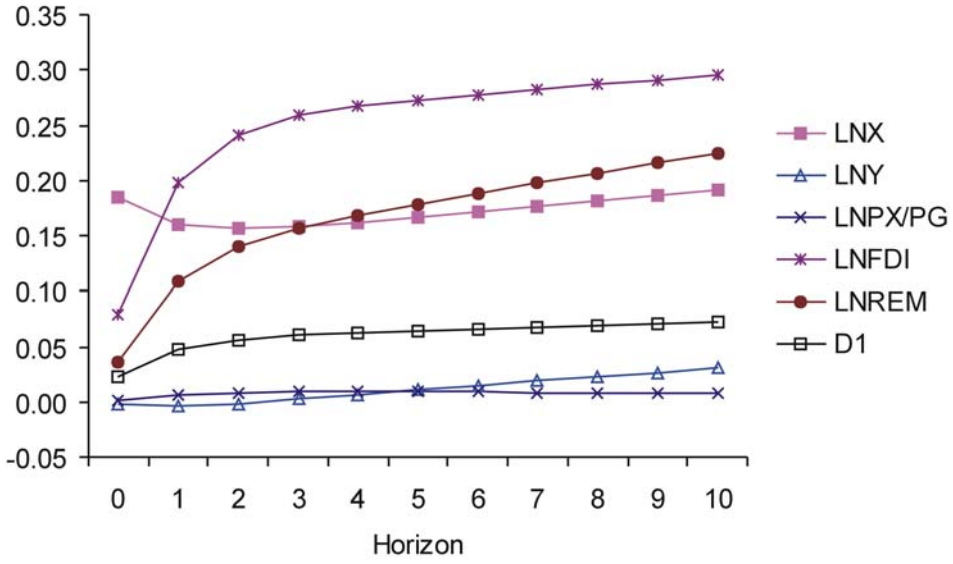
Generalized Impulse Response(s) to One SE shock in the Equation for LNX

Horizon	LNX	LNY	LNPX/PG	LNFDI	LNREM	D_1
0	0.1850	–0.0014	0.0014	0.0783	0.0358	0.0223
1	0.1606	–0.0030	0.0069	0.1987	0.1094	0.0469
2	0.1561	–0.6683E-3	0.0086	0.2414	0.1402	0.0560
3	0.1582	0.0029	0.0090	0.2585	0.1568	0.0601
4	0.1623	0.0069	0.0090	0.2671	0.1686	0.0625
5	0.1670	0.0109	0.0088	0.2729	0.1788	0.0643
6	0.1720	0.0149	0.0087	0.2777	0.1883	0.0659
7	0.1769	0.0189	0.0085	0.2822	0.1976	0.0674
8	0.1817	0.0229	0.0083	0.2865	0.2066	0.0689
9	0.1865	0.0267	0.0081	0.2908	0.2155	0.0703
10	0.1912	0.0305	0.0079	0.2949	0.2243	0.0718

The results of impulse response function for real export model are given in the following Figure 2.

FIGURE 2

Generalized Impulse Response(s) to One SE Shock in the Equation for LNX



IV. CONCLUSION AND RECOMMENDATIONS

Foreign Direct Investment (FDI) has become an important growth factor in the globalization of the world economy. The countries that experienced faster growth rate of GDP were considered successful and have been attracting larger amount of FDI. In developing countries FDI was helpful to narrow down the Saving-Investment gap. A Multinational company's decision to expand its business to another country was mostly based on high efficiency, low production cost, availability of strategic raw material and emerging market. The economic benefits of FDI were wide-ranging; it opened new avenues of knowledge, transfer of technology, training of manpower, market networking and many other spillover effects and externalities in the host countries. Numbers of the developing countries including Pakistan have taken effective policies and aggressively pushing economic reforms to attract foreign investments including FDI. However, the local conditions can restrict the potential benefits produced by FDI despite of instrumental policies.

Many theoretical and empirical research studies were conducted at national and international level related to FDI and most of them were reviewed in the literature. This research study empirically analyzed impacts of FDI on Pakistani imports and exports. The analysis relied on annual time series data over the period of 1973 to 2004. This study applied the Unit roots (ADF test) to check the stationarity of the data used in the analysis. Cointegration was used to analyze the long run relationship among the variables and Error-Correction (EC) techniques to estimates the FDI and other explanatory variables that affect the dependent variables. The results of the import model showed that FDI has positive relation with real demand for imports in the short run and in the long run. The results of export model expressed that FDI has negative relation with real exports in the short-run and positive relation in the long run. The results of import model expressed that one percent increase in FDI; real demand for import would increase by 0.078 percent in the short-run and 0.522 percent in the long run. The export model estimations indicated that one percent increase in FDI, real export would decrease by –0.079 percent in the short-run and increase by 1.623 percent in the long run.

On the basis of this study's results, the following recommendations are suggested for the long-run economic benefits of FDI in Pakistan:

- Policy makers should provide conducive and friendly environment to foreign investors to attract more FDI.
- Foreign investor should be given more incentives for the transfer of technology to host country. This would lubricate the local enterprises.
- For Pakistan import-substitution policy related FDI may prove good.

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APPENDIX

TABLE 1A

Description of Variables

Y	Real Gross Domestic Product (GDP)
Pg	GDP deflator
X	Volume of exports
Px	Unit price of exports
Px / Pg	Relative prices of exports
M	Volume of imports
Pm	Unit price of imports
Pm / Pg	Relative prices of imports
FDI	Foreign Direct Investment
FDI (–1)	Lagged Foreign Direct Investment
Rem	Foreign Remittances
Ln	Natural log
Lny	Natural log y
Lnx	Natural log X
Ln (Px / Pg)	Natural log (Px / pg)
Lnm	Natural log M
Ln (Pm / Pg)	Natural log (Pm / Pg)
Ln FDI	Natural log FDI
Ln FDI (–1)	Natural log FDI (–1)
Lnrem	Natural log rem
D1	Dummy variable

*The year 2000 was taken as base year.

TABLE 2A

ADF Unit Root Test for Stationarity

Variables	Without Trend	With Trend
Lnx	–1.620	–1.573
Lnpx/pg	–2.950	–2.895
Lnpm/pg	–1.563	–3.649*
Lnfdi	–1.572	–2.990
LnTD	–0.555	0.029
Lnrem	–3.718*	–3.412
Lnm	–1.420	–2.494
Lny	–1.650	–0.882
Critical values (0.05 %)	–2.962	–3.567

ADF tests were performed using Microfit 4.1.

*Stationarity at 1(0)

TABLE 3A

ADF Unit Root Test for Stationarity at First Difference

Variables	Without Trend	With Trend
Δ Lnx	–5.261	–5.590
Δ Lnpx/pg	–5.050	–5.244
Δ Lnpm/pg	–4.391	–4.315
Δ Lnfdi	–6.656	–6.846
Δ LnTD	–2.579	–3.681
Δ Lnrem	–2.683	–2.739
Δ Lnm	–3.041	–3.094
Δ Lny	–2.453	–2.878
Critical values (0.05%)	–2.962	–3.567

*ADF tests were performed using Microfit 4.1.

Δ indicates the first difference of the variable used.

TABLE 4A

Order of the VAR for the Real Demand for Import Model

List of variables included in the unrestricted VAR			
Lnm lny lnpmpg lnFDI1 lnrem D1			
List of deterministic and/or exogenous variables			
Constant			
Order	AIC	SBC	Adjusted LR test
8	38.287	30.041	----------
7	39.128	31.471	0.132 [0.716]
6	39.333	32.264	0.795 [0.672]
5	34.340	27.861	5.789 [0.122]
4	33.225	27.364*	7.527 [0.111]
3	33.178	27.877	8.424 [0.134]
2	34.095	29.383	8.493 [0.204]
1	35.092	30.969	8.496 [0.291]
0	34.501	30.967	9.822 [0.278]

NOTE: p – values in the parentheses**.**

AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion

*Minimum value of SBC

TABLE 5A

Johansen Cointegration Results for Real Demand for Import Model

Relationship	Hypotheses		Eigen values	Critical values
	H_0: r	H_a: r		
Lnm	0	1	84.704*	40.530
Lny	1	2	35.481*	34.400
Lnpm/pg	2	3	29.221*	28.270
Lnfdi1	3	4	21.645	22.040
Lnrem	4	5	14.821	15.870
D1	5	6	10.72*	9.160
The critical values were given (p = 0.05 percent) levels for Cointegration.				

*Indicates support for Cointegration

TABLE 6A

Selecting the Order of the VAR for the Real Export Model

List of variables included in the unrestricted VAR			
Lnx Lny Lnpx/pg LnFDI Lnrem D1			
List of deterministic and/or exogenous variables			
Constant			
Order	AIC	SBC	Adjusted LR test
4	12.3928	7.4141	0.821 [1.00]
3	11.2380	6.7572*	1.252 [0.999]
2	11.0334	7.0505	1.252 [0.999]
1	11.4818	7.9967	1.604 [1.00]
0	12.4112	9.4240	1.618 [1.00]

NOTE: p – values in the parentheses.

AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion

*Minimum value of SBC

TABLE 7A

Johansen Cointegration Results for Real Export Model

Relationship	Hypotheses		Eigen values	Critical values
	H_0: r	H_a: r		
Lnx	0	1	92.119*	40.530
Lny	1	2	35.554*	34.400
Lnpx/pg	2	3	28.338*	28.270
Lnfdi	3	4	21.976	22.040
Lnrem	4	5	12.628	15.870
D1	5	6	4.905	9.160
The critical values were given (p = 0.05 percent) levels for Cointegration.				

*Indicates support for Cointegration.

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AN EMPIRICAL ANALYSIS OF PESTICIDE MARKETING IN PAKISTAN

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and MUHAMMAD UMAR MALLAH*

Abstract. This paper investigates empirical analysis of pesticide import trend, marketing margins and incentives of various intermediaries, price index of common insecticides and total outlay of farmers on purchase of pesticides. Estimates of the quadratic regression model revealed steeper growth trend as compared to that of simple linear regression model. Local companies offered high profit margins (up to 30%) and incentive schemes to dealers to get maximum market share as compared to multinationals (up to 15%). Multinational imparted effective training programs for the capacity building of farmers and dealers. The total outlay of farmers on the purchase of pesticide in Pakistan was estimated at Rs. 19.612 billion against import bill of Rs. 8.138 billion for 2003.

I. INTRODUCTION

Government's import and sale policies can be divided into two periods. Pre-February 1980 period; when all pesticide imports were in the public sector and pesticides distributed to the farmers either through the Agriculture Ministry's channels or through the private sector at subsidized rates. Post-February 1980 period; when the new agricultural policy was implemented. Subsidies on pesticides for ground spraying were withdrawn and simultaneously the responsibility for importation and sale of pesticides was transferred to the private sector (Farid-u-ddin, 1985).

During the post February 1980 period, pesticide consumption increased from 906 metric tons in 1980 to 5519 metric tons in 1992. Tariq (2002) reported that during last two decades, there was substantial increase in the use of pesticides not only in volume, but also in value. Its use increased by about 70 times (of which about 80% was used on the cotton crop), while

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cotton yield increased only two-folds. The pesticide value exceeded Rs. 12-14 billions, which added to the cost of production.

Most pesticides used in Pakistan were insecticides (74%), followed by herbicides (14%), fungicides (9%), acaricides (2%), and fumigants (1%) (Khan, 1998). Synthetic pyrethroids were introduced in Pakistan in 1980 when permethrin, deltamethrin, fenvalerate were commercially launched. In five years (1980 to 1985), more than a dozen brands of pyrethroids were made available to farmers. It was estimated that more than 70 percent of the total pesticides market was of synthetic pyrethroids (Malik, 1986). The pyrethroids constituted about 45 percent in terms of value. The phoshphatic group captured 39 percent of the market and share of chlorinated hydrocarbon was 9 percent while carbonate pesticide accounted for 4 percent during 1984 (Memon, 1986).

Rough estimates given by multinational companies showed that almost 80-90 percent of pesticides were used on cotton crop while remaining 10-20 percent consumed on paddy, sugarcane, fruits, and vegetables (Eavy *et al*., 1995). The most serious pest on cotton in Pakistan is whitefly, which is the vector of cotton leaf curl virus. During 1993, cotton leaf curl virus was responsible for an estimated loss of 3 million bales of cotton, equivalent to almost 25 percent of total production. Large amounts of pesticides were, therefore, used to eliminate this insect (Khan, 1998). Province-wise share of pesticide market was 90 percent for the Punjab, 8 percent for Sindh and 2 percent for NWFP and Balochistan (Khan, 2000).

Objectives

The specific objectives of the present study are given hereunder:

1. To develop regression model on the import of pesticides.
2. To analyze the marketing pattern of pesticides by various intermediaries vis-à-vis market share of insecticides, price index, and incentive packages.
3. To estimate total outlay of farmers on the purchase of pesticides in Pakistan.

II. DATA COLLECTION AND ANALYSIS

SECONDARY DATA ANALYSIS

Secondary data collected from Department of Plant Protection, Ministry of Agriculture and Livestock, Karachi were analyzed for meaningful results.

Linear regression model was applied to study growth trend of pesticide consumption during 1980-2003. Linear regression is a method of modeling the conditional expected value of one variable given the values of some other variable(s). The simple linear regression model is typically stated in the form:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

The right hand side may take more general forms, but generally comprises a linear combination of the parameters, here denoted by β_0 and β_1. The term ε represents the unpredicted or unexplained variation in the response variable; it is conventionally called the "error" whether it is really a measurement error or not, and is assumed to be independent of x. The error term is conventionally assumed to have expected value equal to zero. Linear regression can be extended to a quadratic function, which is a polynomial function of the form:

$$y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$$

Quadratic function is sometimes referred as a degree 2 polynomial or a 2^{nd} degree polynomial. The values of the parameters β_0, β_1, and β_2 are estimated by the method of least squares, that minimizes the sum of squares of the residuals (Cohen *et al.*, 2003). Quadratic regression model is one of linear regression models even though it does not represent a straight line. Simple and quadratic models of linear regression are widely used in biological, behavioral and social sciences to describe relationships between variables (Wikipedia, 2007). In the present study, variations of pesticide import in function of time was studied and the above linear regression models were applied for their suitability to define the growth trend during 1980-2003.

Significance of the quadratic model over simple linear model was determined using Fisher's test (Neter *et al.*, 1996). F^*-value was calculated using the following equation:

$$F^* = \frac{SSE_{\text{Reduced Model (Linear)}} - SSE_{\text{Full Model (Quadratic)}}}{df_{\text{Reduced Model}} - df_{\text{Full Model}}} \div \frac{SSE_{\text{Full Model}}}{df_{\text{Full Model}}}$$

The degrees of freedom are those associated with the sum of squares of error (*SSE*) of reduced and full models. Large value of F^* leads to large difference between *SSE (Reduced model)* and *SSE (Full model)* and suggests that due to induction of quadratic term in the simple linear regression model, *SSE* has significantly reduced. The following decision rule was applied for testing the significance of F^*:

If $F^* \leq F\,(1-\alpha, df_R - df_F, df_F)$, drop quadratic term

If $F^* > F\,(1-\alpha, df_R - df_F, df_F)$, retain quadratic term

1. Trend Analysis of Pesticide Import

Table 1 presents the pesticide import during 1981 to 2003. The table shows that only 665 metric tons were imported in 1980, which increased to 17,443 metric tons in 1990, and 61,299 metric tons in 2000 while 78,132 metric tons were imported in 2003. Imported pesticides are both in finished and raw forms. Active ingredients are imported and the same are locally formulated. Proportion of locally formulated pesticides has substantially increased since 1982, when for the first time pesticides were formulated in Pakistan. The share of locally formulated pesticides was recorded to be 29 percent for 1982 and 69 percent for 2003. The proposed quadratic regression model is given as under:

$$Pesticide\ (import) = 5965 - 273.98\ (year) + 124.93\ (year)^2$$

TABLE 1

Pesticide Import during 1980-2003

Year	Imported in finished form (MT)	Local formulated (MT)	Total import (MT)	Value (Million Rs.)	Percentage of local formulation by weight
1980	N/A	N/A	665	39	N/A
1981	N/A	N/A	7,105	225	N/A
1982	3,552	1,448	5,000	320	29
1983	4,875	1,713	6,588	627	26
1984	6,081	3,132	9,213	2,256	34
1985	8,270	4,260	12,530	2,249	34
1986	8,834	5,665	14,499	2,978	39
1987	8,019	6,829	14,848	3,259	46
1988	6,256	6,816	13,072	2,334	52
1989	6,869	7,738	14,607	3,642	53
1990	7,502	9,941	17,443	4,581	57
1991	6,157	14,056	20,213	5,536	62
1992	6,691	16,748	23,439	6,554	71
1993	6,128	14,151	20,279	5,384	70
1994	10,693	14,175	24,868	5,808	57
1995	20,136	23,239	43,375	7,274	54
1996	24,151	19,068	43,219	9,987	44

1997	24,168	13,836	38,004	9,904	36
1998	22,765	18,811	41,576	6,960	45
1999	27,210	18,470	45,680	7,324	40
2000	19,764	41,535	61,299	4,971	68
2001	20,678	26,914	47,592	7,741	56
2002	26,010	42,794	69,897	6,620	62
2003	24,028	54,105	78,133	8,138	69

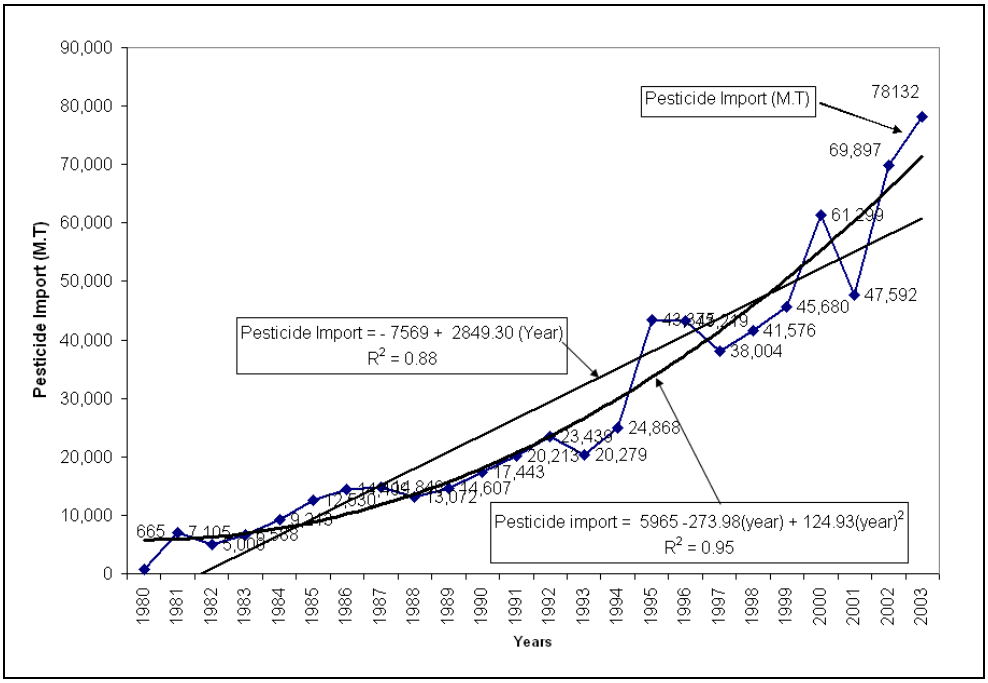
N/A = Not available

Source: Department of Plant Protection, MINFAL, Karachi.

Figure 1 shows the pesticide import trends. Quadratic regression model looks fit well to data because of curvilinear import growth trend. Simple linear regression model represented by a straight line overestimated the import from 1988 to 1994 and underestimated after 2001. Widening gap between estimated values obtained by using simple linear regression model and actual import after 2001 revealed that the linear model may not be proposed for the prediction of pesticide import.

FIGURE 1

Regression Model for Pesticide Import during 1980-2003



SPSS output for linear and quadratic regression models is presented in Box 1 and 2, respectively. Sum of squares of error (SSE) of linear and quadratic models as well as their corresponding degrees of freedom were used to estimate F^* as discussed earlier. F^*-value was estimated at 24.41, which was highly significant ($p < 0.01$); since the tabulated value of F (8.02) against 1 ($df_{Full} - df_{Reduced}$) and 21 (df_{Full}) degrees of freedom at 0.01 level of significance was less than calculated F^* value. From this, it was concluded that quadratic regression model explained significantly more proportion of variance of pesticide import in comparison of ordinary linear regression model.

$$F^* = \frac{1{,}273{,}321{,}650 - 588{,}850{,}452}{22-21} \div \frac{588{,}850{,}452}{21} = \frac{684{,}471{,}198}{28{,}040{,}498} = 24.41$$

BOX 1

SPSS Output of Linear Regression Model for Pesticides Import during 1980-2003

```
Dependent variable.. IMPORT           Method.. LINEAR
Listwise Deletion of Missing Data
Multiple R           .93807
R Square             .87998
Adjusted R Square    .87453
Standard Error   7607.77608

            Analysis of Variance:

               DF   Sum of Squares      Mean Square

Regression      1     9336281364.9     9336281364.9
Residuals      22     1273321650.4       57878256.8

F =     161.30896       Signif F =  .0000

-------------------- Variables in the Equation --------------------

Variable                B     SE B        Beta        T          Sig-T
(Constant)        -7568.57    3205.54                 -2.361      .0275
YEARS              2849.30     224.341    .938075     12.701      .0000
```

Based upon the better visual impression, significant F^*-value ($p < 0.00$) due to induction of quadratic term in the simple linear model and higher R-square (0.95) value, quadratic linear regression model was proposed for pesticide import in Pakistan. The specified model fitted well to the given data

and depicted that import of pesticide did not follow a simple linear regression model; rather, it followed quadratic type relationship in Pakistan.

BOX 2

SPSS Output of Quadratic Regression Model for Pesticide Import during 1980-2003

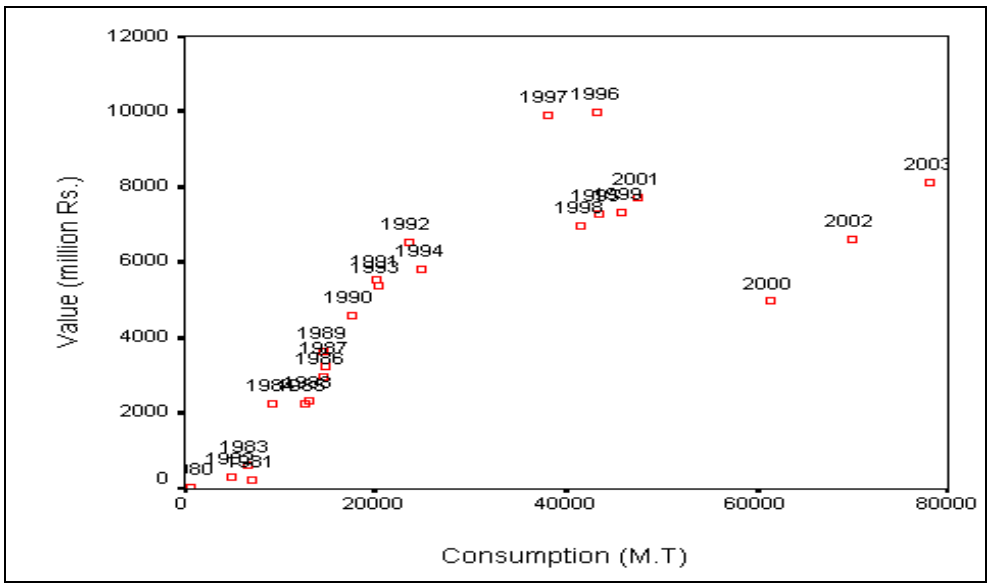
```
Dependent variable.. IMPORT          Method.. QUADRATIC
Listwise Deletion of Missing Data
Multiple R           .97185
R Square             .94450
Adjusted R Square    .93921
Standard Error   5295.32791

           Analysis of Variance:

              DF   Sum of Squares      Mean Square
Regression     2    10020752563.3     5010376281.6
Residuals     21      588850452.1       28040497.7

F =     178.68357       Signif F =  .0000

------------------- Variables in the Equation --------------------

Variable                 B         SE B       Beta        T     Sig-T
Constant)              5965.00     3533.05                 1.689 .1061
YEARS                  -273.98      651.16     -.09        -.421 .6782
YEARS**2                124.93       25.29     1.06        4.941 .0001
```

2. Quantity and Value of Pesticides Import during 1980 to 2003

Figure 2 shows the pesticide import and its corresponding value during 1980 to 2003. The figure shows that there is linear relationship between total pesticide import and its value from 1980 to 1997. After 1997, the quantity of imported pesticide has increased, however, its value has dramatically decreased especially during 2000. The main reasons for this decline were a reduction in prices in global market (Shahid, 2003) and increased share of active ingredients for local formulation in comparison of pesticides import in finished form. Declining price trend of pesticides indicated that pesticide demand was globally decreasing. Ghani (2002) reported that total market of pesticide was about $ 30 billion during 1999-2000, which declined to about $ 24 billion dollars during 2001-02.

FIGURE 2

Quantity and Value of Pesticides Import during 1980-2002



PRIMARY DATA COLLECTION

Multistage cluster sampling was applied to select representative samples of respondents. Cluster sampling has two important advantages over Simple Random Sampling and Stratified Sampling. Firstly, it is economical and secondly it is suitable for selecting a sample when the sampling frame of individual elements is not available. Cluster Sampling only needs a list of elements in the clusters sampled (Anderson *et al.,* 1993).

The target area of present study was limited to three cotton producing districts of Sindh, namely Sanghar, Nawabshah, and Naushahro Feroze. Sanghar district is the top most cotton producing district of Sindh. In 2003-04, Sanghar district produced 637,772 bales out of Sindh province total production of 2,129,553 bales-almost 30 percent (Aziz, 2005).

Multistage cluster sampling was applied to select sample respondents from three districts. In the first stage, one *tehsil* from each district was randomly selected as per plan depicted in Table 2. According to information provided by District Offices (Agriculture), there were 16 pesticide dealers in Nawabshah city, 16 in Shahdadpur, and 3 in Bhiria City; thus, in all, there were 35 pesticide dealers in three *tehsil* headquarters. The following equation, suggested by Tryfos (1996), was used to determine the representative sample size:

$$n = \frac{N\pi(1-\pi)}{(N-1)\left(\frac{C}{Z_{a/2}}\right)^2 + \pi(1-\pi)}$$

Where n is recommended sample size, N is population size, π is characteristic of interest, C is ± error rate, and $Z_{a/2}$ is tabulated value for confidence interval. Using the above equation, a sample of 23 pesticide dealers was suggested for proportion of 0.5, which gives the maximum variance of 0.25 $[0.5 \times (1 - 0.5) = 0.25]$, error rate of ±10%, and 90% confidence interval. The suggested sample of pesticide dealers was divided into three *tehsil* headquarters disproportional to their population sizes because the number of pesticide dealers in Bhiria City was quite small as compared to other two *tehsils*. The sampling plan is depicted in Table 2. A sample of 10 pesticide dealers from Shahdadpur, 10 from Nawabshah, and 3 from Bhiria were selected for the study.

TABLE 2

Cluster Sampling Plan for Selection of Dealers

District	Tehsil	Selected Tehsil Headquarter	Pesticide Dealers	
			Population	Sample
Sanghar	Sanghar Jam Nawaz Ali Khipro Shahdadpur Sinjhoro Tando Adam	Shahdadpur	16	10
Nawabshah	Daulat Pur Safan Nawabshah Sakrand	Nawabshah	16	10
Naushahro Feroze	Bhiria Kandiaro Moro N. Feroze	Bhiria	3	3
Total		3 Tehsils	35	23

There were 87 pesticide firms/companies registered with the Directorate General, Agriculture Extension, Hyderabad, Sindh in 2003-04. On the basis

of key informant input, it was ascertained that there were about 30 pesticide companies in the study area selling pesticides through their active sales network. Using the above equation for the population size of 30, proportion of 0.5, error rate of ±10%, and confidence interval of 90%, a representative sample size of 19 was determined. Nineteen companies were randomly selected. From each selected company one sales executive was purposively selected; randomization was not possible because of mobile nature of job of sales executives.

PRIMARY DATA ANALYSIS

Primary data regarding marketing of pesticides in the study area are presented as under:

1. Market Share of Insecticides

Sale in terms of quantity (metric tons) and in terms of value (million Rs.) sold during 2003 is presented in Table 3. The table shows that during 2003, the total sale by weight was 970.75 metric tons. Shares of companies by status indicated that 23.4 percent of total sale was hoarded by multinational companies while the shares of national and generic companies were estimated at about 32.1 and 44.5 percent, respectively.

TABLE 3

Company Status-wise Sale of Insecticides

Status of the companies		Sale of pesticides by weight (MT)	%age	Sale of pesticides in million Rs.	%age
Multinational		227.14	23.4	152.18	32.2
Local	National	311.50	32.1	124.35	26.4
	Generic	432.11	44.5	195.20	41.4
Total		970.75	100.0	471.73	100.0

Pesticide market of the study area (in terms of value) was estimated to be Rs. 471.73 million. Calculated shares of the multinational, national, and generic companies were 32.2, 26.4 and 41.4 percent, respectively. Difference between the shares of multinational companies in terms of weight and value was due to higher prices of their products as compared to prices offered by local companies. The combined share of local companies (national and generic) was 68 percent. This estimated share of local companies was in

general agreement with that of Novartis (2000) report that the share of local companies was 60 percent in Pakistan. This showed that during three years, the share of local companies increased from 60 percent in 2000 to 67.8 percent in 2003 (when data were collected for the present study) due to induction of new local companies in the pesticide market.

Top ten insecticides sold in the study area in terms of weight during 2003 were summarized in Table 4. The table revealed that highest selling pesticide in the study area was methamidophos, fetched 28.6 percent of all the insecticides followed by endosulfan (12.2%), cypermetherin (9.4%), imidacloprid, (7.6%), fenpropthrin (6.6%), chlorpyrifos (4.6%), bifenthrin (4.3%), profenophos (3.8%), fenvalerate (2.8%), and monocrotophos (2.3%). These pesticides belong to organophosphate, organochlorine and pyrethroid groups, respectively. The estimates can be supported by survey findings of a study conducted by Saleem and Arshad (2005) who reported that most of the pesticides applied in Pakistan were class one as classified by the WHO like monocrotophos, methamidophos, endosulfan and carbufuran. These hazardous pesticides played havoc with biodiversity, environment, and public health standards.

TABLE 4

Top Ten Insecticides in Terms of Weight

Insecticide	Sale of pesticides in weight (MT)	%age
Methamidophos	277.4	28.6
Endosulfan	117.98	12.2
Cypermetherin	90.92	9.4
Imidacloprid	73.5	7.6
Fenpropthrin	63.98	6.6
Chlorpyrifos	44.93	4.6
Bifenthrin	41.7	4.3
Profenophos	36.7	3.8
Fenvalerate	27.6	2.8
Monocrotophos	22.3	2.3
Others	173.74	17.9
Total	970.75	100.0

Organophosphates can slowly poison by attacking an essential body enzyme called “cholinesterase”. The chronic exposure to organophosphate

pesticides can be measured by monitoring changes in blood cholinesterase levels. In humans, decreased blood cholinesterase levels are a sure sign that exposure to these types of pesticides should be avoided until the level is measured as being normal again (PMEP, 2004). Tahir *et al.* (2001) conducted a study in Multan and Bahawalpur divisions to assess the level of poisoning among cotton pickers. The results of blood analysis showed that the post spray season ChE activity in blood sample of only 10 percent female pickers was found to be in the normal range of 88-100 percent whereas this level was hazardous (00-50 percent) among 42 percent of the pickers.

Besides health hazards, the available literature indicated that insects have developed resistance to common insecticides. Whitefly has developed resistance against methamidophos and it should not be used more than once in the season (CCRI, 2004). Further, it was reported that pesticides of pyrethroid group help in resurgence of whitefly.

2. Price Index of Some Common Pesticides

Table 5 revealed the ratios of prices of farmers' price (maximum retail price) and importers' price. The average ratio for local companies was about 2.32, which indicated that a pesticide was imported for Re. 1 and was sold to farmers for Rs. 2.32 while for multinational companies the average ratio was 2.50. This ratio varied from 1.84 for profenophos 40 EC to 4.17 for cypermetherin 10 EC. The weighted average ratio was 2.38.

The weighted average ratio was calculated on the basis of 68 percent of total pesticides sold by local companies and 32 percent by multinational companies (Table 3). Using these estimates, the total outlay of farmers on the purchase of pesticide in Pakistan was calculated by multiplying import bill with 2.41. The estimated outlay was calculated to be Rs. 15,754 million for 2002 and 19612 million for 2003. Chaudhry (2004) reported that total volume of the pesticide market in Pakistan presently stood at US $ 250 million (Rs. 15 billion) during 2002, being a significant market in regional perspective. From this, it may be concluded that the pesticide market has increased from Rs. 12-14 billion as reported by Tariq (2002) for 2000 to about Rs. 15 billion for 2002 (Chaudry, 2004) and 19.6 billion for 2003, estimated by this study.

Marketing margins of channels of local companies were 36 percent for importers, 35 percent for distributors, and 26 percent for dealers. Multinational companies did not sale their products to distributors, but they had their own marketing arrangements. Marketing margins of multinational and their dealers were estimated at 126 and 11 percent, respectively.

TABLE 5

Price Index of Some Common Pesticides

Pesticide	Local Companies				
	Importer	Distri-butor	Dealer	Farmer	$\text{Price} = \frac{\text{Farmer's Price}}{\text{Importer's Price}}$
Abamactin 1.8 EC	250	310	410	525	2.10
Accetamaprid 20 SP	300	360	500	700	2.33
Bifenthrin 10 EC	400	600	850	1000	2.50
Cypermetherin 10 EC	60	150	180	250	4.17
Fenproptherin 20 EC	175	235	350	425	2.43
Imidocloprid 25 WP	285	340	450	600	2.11
Profenofos 40 EC	190	240	300	350	1.84
Methamidophos 60 SL	90	145	180	210	2.33
Total	1750	2380	3220	4060	
Price index	100	136	184	232	
Marketing Margin	36	35	26		
Multinational companies					
	Importer	Dealers	Farmer	$\text{Price} = \frac{\text{Farmer's Price}}{\text{Importer's Price}}$	
Curacran 50EC	180	385	428	2.38	
Politerin C 440EC	240	589	670	2.79	
Karate 2.5EC	180	404	460	2.56	
Deltafos 360EC	250	719	750	3.00	
Thiodan 35EC	120	305	350	2.92	
Confidor 200 SL	600	1000	1100	1.83	
Buctral 60 EC	200	410	550	2.75	
Larin 20 EC	550	1422	1500	2.73	
Total	2320	4734	5808		
Price index	100	226	250		
Marketing Margin	126	11			

3. Incentive Schemes for Pesticide Dealers

Each pesticide company has its own incentive scheme for the dealers. Usually companies collect money in advance from dealers in December and January for the pesticides supplied in May and June (start of insect pest season). This scheme is known as “booking” while during the remaining period dealers purchase the pesticide on cash basis – the cash scheme. Local companies offer very lucrative incentives as a part of booking scheme,

including foreign tours of Bangkok, Dubai and Malaysia. Area Manager of a national company informed that their booking scheme offered Dubai tour with a price tag of Rs. 0.2 million to the dealers. In another package, 30 percent of sale through booking scheme was given in cash known as "cash incentive". Besides, during tour, lottery schemes for dealers ranged from Rs. 0.02 to 5.00 million only were offered. It was estimated by the researcher that the booking scheme offered almost 40 percent in profits and incentives to the dealers. In cash schemes, the local companies offer 15 to 20 percent of purchase to the Dealer.

Data gathered to know the incentive schemes of pesticides companies for dealers revealed that generic and national companies offered more incentives through different schemes (cash prizes and foreign tours) to the dealers to get maximum market share. The same findings are more visible in the survey report of NFDC (2002) stating that pesticide companies have gone over broad offering incentive schemes like "Bhangra scheme" whereby various prices and lottery tickets are used to promote sales. In certain cases this led to over use of pesticides and at times poor grade and discarded pesticides are dumped in the market with major losses to the farming community.

Multinational companies apparently do not offer such incentives of tour and lottery to the dealers. Sales executives of multinational companies did not share specific information with the researcher regarding incentive schemes for dealers. Direct margins offered to dealers were reported to be as low as 2 percent. The researcher, however, collected information from the dealers and determined that on the booking scheme 15 percent was offered while on cash scheme, 8 percent was offered. Because of higher sale of multinational products, dealers were found satisfied with the lower margins since the absolute level of profits was higher.

Bargaining over pesticides of local companies is a common phenomenon in the pesticide market while prices of pesticides of multinational companies are fixed. Sales executives of the multinational companies stated that majority of farmers purchase pesticides from dealers on credit; and that the dealers do choose often substandard pesticides which are available at their shops and make substantial profits in the process.

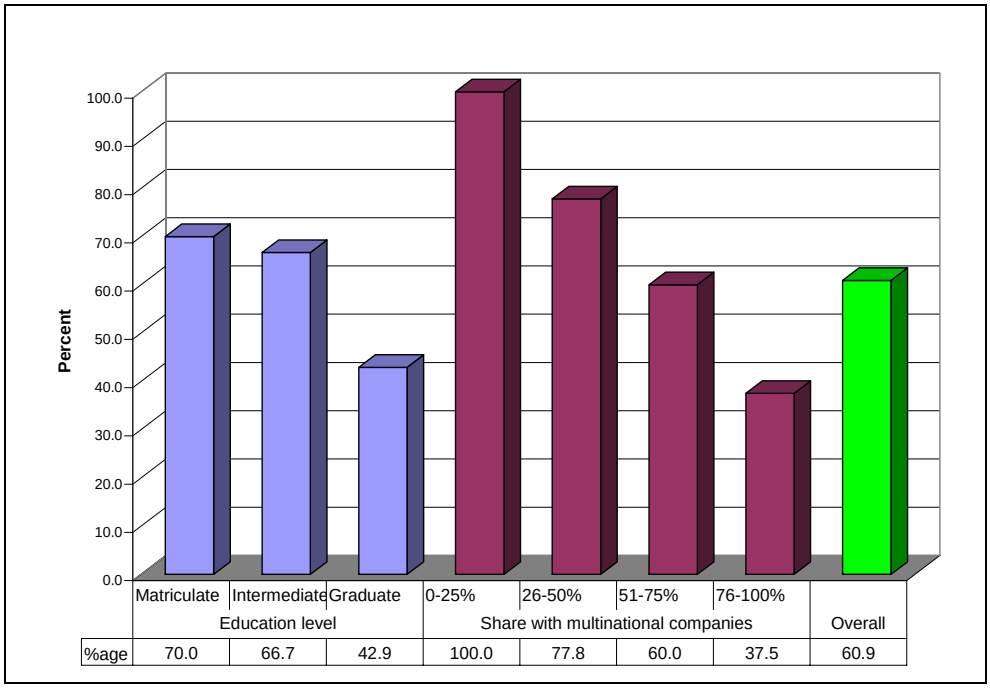
Multinational companies provided incentives against good sale to their dealers in kind rather than cash. They imparted high profile trainings to dealers for their capacity building in various areas of crop protection, record and shop management, sale forecast, and computer packages. Some of the multinational companies provided furniture, computers, and latest computer programs for the identification of diseases and insect pests.

4. Sale of Pesticides on Credit

Figure 3 unveiled that 60.9 percent of the pesticide dealers offered pesticides on credit. The segregated data based upon educational level showed that 70 percent matriculate, 66.7 percent intermediate, and 42.9 percent graduate dealers offered pesticides on credit. This trend shows that more educated dealer preferred sale of pesticide on cash terms.

FIGURE 3

Sale of Pesticides on Credit



Share of multinational companies in total sale of pesticide dealers was divided in four categories, *viz.* I (0 to 25%), II (26 to 50%), III (51 to 75%), and IV (76 to 100%). Strong negative relationship between the share of multinational companies and the sale of pesticides on credit was observed. All the dealers belonging to category I, 77.8 percent from II, 60.0 percent from III, and 37.5 percent from IV were recorded to be offering pesticides on credit. The obvious reason of this trend was that the multinational companies did not offer pesticides on credit to dealers. As a result, less proportion of dealers working with multinational companies offered pesticides on credit to growers. Moreover, the multinational companies offered reasonable profit margins on the sale of pesticides whereas local companies offered very lucrative profit margins through different incentive schemes, as a result the

risk of the unrecoverable amount from unfair growers was met with the hefty profits made on the recoverable amounts. NFDC (2002) reported that pesticide dealers and commission agents provided service of extending credit for the purchase of pesticides.

III. CONCLUSIONS

Consequent upon the institution of liberal policies by the Government of Pakistan in 1980s, aimed at transferring the import and sale of chemical pesticides to the private sector, numerous companies entered the country's pesticide market. Quadratic regression was proposed for the import of pesticides in the country. Estimates of the proposed model revealed steeper growth trend than that of ordinary regression model.

Total outlay of farmers on the purchase of pesticide in Pakistan was estimated at about Rs. 19.6 billion during 2003. Local companies offered high profit margins (up to 30%) and incentive schemes including lotteries and foreign tours to the dealers who, in addition, charged exorbitant interest rate of 30 to 40 percent per annum from the farmers while giving pesticides on loan. Unlike local companies, multinationals offered normal profit margins (up to 15%) to dealers, supplied quality pesticides and imparted training programs for the capacity building of farmers and dealers. Total sale amount of insecticides in Sanghar, Nawabshah, and Naushahro Feroze districts was estimated to be Rs. 471.73 million in 2003-04. Top five insecticides in terms of weight were methamidophos (29%), endosulfan (12%), cypermetherin (9%), imidacloprid, (8%), and fenpropthrin (7%). The above ranking reflected the persistence of old groups of pesticides, *i.e.* organophosphate, organochlorine and synthetic parathyroid in the market; while the recent literature revealed that cotton insect pests had developed resistance to these groups.

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STUDENTS' ATTITUDE TOWARDS MATHEMATICS

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Abstract. Students' success in mathematics depends upon attitude towards mathematics. It also influences the participation rate of learners. This study was based on a survey of high school students about their attitudes towards mathematics. Students of both the gender constitute the population of this study. Sample of the study was 685 students (male = 379 and female = 306) of 10^{th} grade selected conveniently from 10 private and public sector schools. A questionnaire ($\alpha = 0.7452$) was used to examine the attitudes of male and female students towards mathematics at secondary school level. Descriptive statistics and t-test with $P < 0.05$ level of significance were used for data analysis.

I. INTRODUCTION

Attitude towards mathematics plays a crucial role in the teaching and learning processes of mathematics. It effects students' achievement in mathematics. The teaching method, the support of the structure of the school, the family and students' attitude towards school affect the attitudes towards mathematics. Usually, the way that mathematics is represented in the classroom and perceived by students, even when teachers believe they are presenting it in authentic and context dependent way stands to alienate many students from mathematics (Barton, 2000; Furinghetti and Pekhonen, 2002). Researches concluded that positive attitude towards mathematics leads students towards success in mathematics. Attempt to improve attitude towards mathematics at lower level provides base for higher studies in

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mathematics. It also causes effect in achievement of mathematics at secondary school level (Ma and Xu, 2004).

Girls are often discouraged from mathematical work in their primary years. They therefore dislike it in the secondary years. So they drop it at high grade levels in far greater numbers than boys. As a result, fewer women are employed in industry in post needing mathematical ability (Arnot, David and Weiner, 1989). Male and female learners of mathematics have almost same type of achievement scores, because this gender based gap is decreasing day by day. But still research indicates that this difference prevails in some areas of complex mathematical tasks. Attitude is based on value and belief, as well as varying degree of factual knowledge (Mullis, Martin, Gonzalez, Conner, Chrostowski, Gregory, Garden and Smith, 2001). Still the consequences about the gender differences in subject of mathematics are not conclusive because there are so many other factors which contribute towards achievement (Leder and Taylor, 1995; Leeson, 1995; Malone and Miller, 1993). "Poor attitude towards mathematics has often been cited as one factor that has contributed to lower participation and success of girls in mathematics" (Willis, 1995; Fullarton, 1993). Interest and attitude in the subject are the special predictors for the students' participation and success in the subject. Gender based differences are due to the individual's perception of own abilities and the sex role (Schiefele and Csikszentmihalyli, 1995).

Costello (1991) reported that "almost all literature on this topic points to the commonly held perception that doing mathematics is consistent with a male self-image and inconsistent with a female self-image." This self image is usually caused by the peer pressure. Males are more inclined towards mathematics than females on being the male dominated domain. It is found that at secondary school level most of the girls don't actively participate in mathematics classes due to their poor perceptions about mathematics. Girls are negatively influenced by their sex-role stereotypes (Boswell, 1979; Fennema and Sherman, 1977; Sherman, 1882; Leder, 1982 and Ethington, 1992).

Poor mathematical skills in women deprived them from a large number of professions because in some countries mathematical background knowledge is the pre requisite for entrance in any profession. Sex differences are the serious concerns for the communities (Willis, 1995; Cuttance, 1995; Barnes and Horne, 1996). In this era of science and technology, every field of life has been tremendously changed so it is necessary to compare the attitudes and achievements in mathematics on gender basis. It will support us for designing programs and strategies for participation of girls in

mathematics at higher level. It's a common observation that at higher levels females take mathematics quite lesser than the male students. Ultimately the males fill more vacancies based on knowledge of mathematics than the females. Females do not prefer mathematics at higher level because they perceive it as a male domain. All professions requiring higher level knowledge of mathematics are dominated by male community. Many barriers are there for the female students to have their career in mathematics. Some times they feel pleasure in taking mathematics but their parents consider it as a useless effort for them. Sometimes female students' show less confidence in mathematics than their male counterparts. Their attributions of failure and success also differ (Leder, 1984; Subotnik, 1988; Cohen and Kosler, 1991; Hanson, 1992; Dickens and Cornell, 1993).

Several measures and intervention programs has been designed for improving females attitude towards mathematics (American Association of University Women, 1992; Mulryan, 1992). Observations and researches indicate that "women are clustered in the life sciences with far fewer in physical sciences, mathematics, and engineering and computer science" (Gavin, 1997). Ainley and Fordham (1991) contributed for the excellence of school life and its relationship with other features. They investigated the student teacher relationship and concluded that student's satisfaction with school is not correlated with his academic success. This was concluded on the basis of the studies conducted on attitudes towards mathematics. Teachers of mathematics tried to find out relationship of attitude with student's performance in mathematics during the last decade. They came to know that teaching learning process of mathematics depends upon the positive attitude towards mathematics. Serious efforts should be made to develop and gauge the positive attitude towards mathematics. Student's confidence is another ingredient for education of mathematics. "Having a positive attitude towards mathematics means generally enjoying working with mathematics and having confidence in one's own ability to do it but it does not mean that a student will display this positive attitude towards the whole area of mathematics all the time (Robson, 1996). Majority of the students love mathematics but those who dropout due to mathematics have a different viewpoint about it. It leads towards the fact that mathematics is a rough and tough subject. It is the attitude of the student which contributes a lot towards his perception about mathematics. It develops the adaptability and applicability in the learners (Booker, Briggs, Davey and Nisbett, 1992; Schiefele and Csikszentmihalyi, 1995). Students should be encouraged and prepared for accepting the challenges of day to day life (Mathematical Sciences Education Board and National Research Council, 1989). A study

was needed to see the attitude of Pakistani students towards mathematics. This study will answer the possible questions regarding the attitude and achievement in mathematics.

NULL HYPOTHESES

H_{01}: There is no significant effect of gender on student's attitude towards mathematics at secondary school level.

H_{02}: There is no significant difference in confidence of male and female students towards mathematics at secondary school level.

H_{03}: There is no significant difference in male and female students about the usefulness of mathematics at secondary school level.

H_{04}: There is no significant difference in male and female students about the mathematics as male domain at secondary school level.

H_{05}: There is no significant difference in male and female students about the mathematics teacher perception at secondary school level.

II. METHOD AND PROCEDURE

The following methods and procedures were adopted to conduct this study.

POPULATION AND SAMPLE

Students of both the genders constitute the population of this study. Sample of the study was 685 students (male = 379 and female = 306) of the 10^{th} grade from five private and five public sector schools selected conveniently.

INSTRUMENT FOR THE STUDY

Attitudes were measured by using Urdu translated Fennema-Sherman Mathematics Attitude Scale. It consisted of 47 statements. This instrument was developed for measuring attitude of male and female students towards mathematics (Fennama and Sherman, 1976). It consisted of four subscales: a confidence scale, a usefulness scale, a teacher perception scale and a male domain scale. Each of these subscales comprised of 12 items. Six of them measured a positive attitude and six measured a negative attitude. This instrument was based on five point Likert scale. By adding the score for each subscale, the total for that attitude was obtained. The highest possible score for each subscale was 60 points. This adapted form of instrument was pilot tested and the reliability coefficient was found $\alpha = 0.7452$.

RESEARCH DESIGN

This study was descriptive in nature. Survey method was used for data collection.

III. ANALYSIS AND INTERPRETATION OF DATA

Data were collected on the scale from 685 respondents. This data were analyzed through SPSS by applying statistical measures accordingly. The results were interpreted by comparing the means and by using the t-test at $P < 0.05$, level of significance.

TABLE 1

Difference of Male and Female Students' Attitude towards Mathematics

Variables	Mean (N = 685)		t-value
	Male (N = 379)	Female (N = 306)	
Confidence about mathematics	40.14	40.73	1.276
Usefulness of mathematics	36.79	37.34	1.091
Mathematics as male domain	32.89	34.72	4.497
Perception about Teacher	39.59	40.29	2.298
Total	149.41	153.08	2.3

*Significant at $P < 0.05$ level of significance.

The t-value (1.276) for confidence about mathematics is not significant at $P < 0.05$. Therefore, null hypothesis that there is no significant difference in confidence of male and female students towards mathematics at secondary level is accepted at 0.05 level of significance. The t-values (1.091) for usefulness of mathematics, (4.497) for mathematics as male domain and (2.298) for perception about mathematics teachers are not significant at $P < 0.05$ level of significance. The null hypotheses (H_{03}, H_{04} and H_{05}) that there is no significant difference in male and female students about the usefulness of mathematics, mathematics as male domain and mathematics teachers perception at secondary school level are, therefore, accepted. Furthermore the mean score values indicated that there is no such difference in male and female students on the above indicated variables. The t-value (2.3) for total attitude mean scores indicates that there is no significant difference between the total mean scores of male and female students

towards mathematics, therefore, the null hypothesis that "there is no significant effect of gender on students' attitude towards mathematics at secondary school level" is accepted at 0.05 level of significance.

IV. CONCLUSION

The results of this study lead us to an important conclusion. The male and female students of 10^{th} grade of the secondary schools of Lahore have same type of attitude towards mathematics. It means that gender differential has no impact on the attitude of students towards mathematics in Pakistan.

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