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Supply Response to the Rice Price Policy in Pakistan: A Reappraisal

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Abstract: The study re-examines supply response of rice growers to changes in three sets of prices. As regards basmati acreage and yield, the three sets of prices were found to be positively related along with lagged acreage and lagged yield. The fertilizer factor was also important in basmati yield model. The factor of pesticide use was also found to be positively related to yield of basmati rice. The factor of 'rainfall' is of no importance as regards acreage and yield of basmati. It proved rather a 'spoiler'. As regards IRRI acreage, lagged acreage along with lagged rainfall was found to be positively related to acreage. The procurement price was found to be negatively related to acreage of IRRI. This may be ascribable to relatively weaker price incentives and substitution of IRRI rice area with basmati and other rice varieties. The yield of IRRI rice however responds positively to price incentives along with factors of lagged yield, lagged pesticide use and fertilizer.

Keywords: Rice Price Policy, Basmati, IRRI, acreage, yield
JEL Classification: 060, L6

1. Introduction

The Output Price Policy has been used by economic decision makers in Pakistan since the early 1960s, as an incentive for farmers and to expand production frontiers of different crops. During the early years after independence, the government did not use this policy due the widely held view that subsistence farmers in developing countries are not responsive to price incentive. It was a general perception that they produce only for self-consumption and are not influenced by prevailing market prices. The later studies however showed that in Pakistan farmers do respond positively to changes in prices of important food and cash crops and adjust their acreage decision accordingly. This prompted the government to use the policy in the 1960s for expanding production.

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The Rice Price Policy has undergone change in the recent years and there is also a reorganization of the institutional framework. Rice is a crucial crop and occupies important place in the export economy of Pakistan besides being a food supplement to wheat. The rice policy since late 1970s and early 1980s has undergone many changes.

Firstly, the compulsory procurement policy was replaced with voluntary procurement policy. Secondly, the ban on inter-district movement of rice was discarded. Thirdly, the Rice Export Corporation of Pakistan (RECP) which was created in 1974 and assigned the responsibility of procurement and export of rice in the public sector was disbanded in 2000 and merged with the Trading Corporation of Pakistan. The important thing however was that the government opted out of export business and decided to discontinue fixation of rice prices. This was done to allow market forces to prevail in the area of rice production and export. The price now fixed is only 'indicative' in character. The Agricultural Prices Commission (APCOM) responsible for recommending procurement and support prices has been recast and renamed as the Agricultural Prices Institute (API).

Originally, the support price program covered crops like wheat, rice, sugarcane, cotton, potatoes, onions, grams, and non-traditional oil seeds such as sunflower, soybean, canola and safflower. In May 2001, on recommendation of the MINFAL, the Economic Committee of the Cabinet (ECC) reduced the coverage to wheat, rice, sugarcane and cotton crops. In September 2002, the ECC decided to further limit it to wheat, rice and cotton at the federal level while price of sugarcane was to be determined by the provinces. The government has opted out of the export business and both RECP and CECP have been disbanded and merged with the Trading Corporation of Pakistan (TCP).

Since then the thinking on fixation of prices has undergone a major change with the acceptance of an enhanced role for the markets. The coverage has thus been restricted to wheat and cotton only. At present support price system has been eliminated in almost all the crops. The prices fixed are only 'indicative' in character and provide growers a base level for negotiating better prices for themselves.

The Rice Exporters Association of Pakistan (REAP) has taken the place of RECP as regards procurement and export of rice. The TCP facilitates

fulfilment of orders in consultation with the REAP. The government has also established a Quality Review Committee (QRC) that certifies the quality of rice before shipment.

This study aims to re-examine supply response to changes in prices of rice – both basmati and IRRI varieties and to initiate a reappraisal of the Agricultural Prices Policy with particular focus on rice commodity. The rationale of the study is also found to be in the fact that supply response has been estimated against three sets of prices i.e. procurement prices, consumer prices and export prices. The earlier studies used only procurement prices to examine the supply response. The supply response has also not only been estimated for rice price in general but against prices of its two important varieties in Pakistan namely basmati and IRRI. It must be reiterated here that it is always useful to re-examine an old issue to monitor impact of change in policy after regular intervals.

2. Literature Review

There are many studies around confirming the positive supply response of farmers to changes in price. Some of these are recent while some others go back as far as early 1960s. Krishna (1963) used Nerlovian model in his study and concluded that farmers in East Punjab in India and in West Punjab of Pakistan were not unusually slow as compared to their counterparts in America in adjusting to changes in their price system. Eddie (1971) studied the case of Large-Estate agriculture in Hungary using long time series data and concluded that price responsiveness was not radically different to either underdeveloped countries or a developed country like Germany. Koc (1999) estimated the impact of own-price and substitute price changes on supply of major field crops in Turkey and found it significantly responsive to both own-price and substitute price changes. Mythili (2006) studied the supply response of Indian farmers in pre and post reform periods and found no significant difference in supply elasticities between pre and post reform periods for majority of crops. Similarly, Rezitis (2008) studied beef supply response in Greece due to price volatility under the Common Agricultural Policy of the European Union during the period 1993-2005. The study showed that price volatility and feed price significantly explain the supply response model.

A number of studies have been conducted in Pakistan as well, measuring price responsiveness of crops in general, as well as rice crop in particular. Stern (1962) studied supply responsiveness of Indian cultivators of jute. The study found a fairly pervasive influence of the price system even in an underdeveloped India with primitive modes of production. Similarly, Falcon (1964) and Cummings (1975) also confirmed supply responsiveness of farmers in Pakistan to change in prices of important food as well as cash crops. Askari and Cummings (1977) also studied varying supply responsiveness using the Marc Nerlove's seminal model of 1958. Their study revealed diversity of supply responses and the estimated elasticities for the same crop in different regions and different crops in the same region. Farooq *et al.* (2001) also studied supply response of Basmati rice in Punjab, Pakistan and concluded that very high support prices are required to achieve production targets. Shafiq (2005) in his Ph. D. thesis evaluated supply response of major crops in different agro-ecological zones in Punjab, Pakistan. He used cointegration approach in preference to Nerlove's model. He highlighted the importance of other factors such as irrigation and drainage, infrastructure, availability of inputs and access to these inputs in guiding agricultural production. According to him, price policy should not be the exclusive policy option.

Conclusively, it can be stated that policy makers are vitally interested in knowing the degree to which farmers respond to price and nonprice factors and studies should be conducted from time to time to evaluate the impact of incentives on agricultural production.

3. Methodology

Supply response function of both Basmati and IRRI varieties of rice was estimated against three sets of prices namely procurement, consumer and export prices. Since production is a function of both acreage and yield, therefore factors influencing acreage and yield in turn affect production. Thus, instead of one single production function, supply response was estimated by two response functions- one for the area and the other for yield. In the case of the Acreage Model, lagged three sets of prices of rice of the two varieties, lagged area under rice, and rainfall during the sowing season were pressed into service. Yield of rice is likely to be influenced by lagged price of rice, lagged yield of rice, fertilizer and pesticide use

and lagged rainfall. Regression technique was used to estimate acreage and yield models.

Procurement price is taken as Rs. 40 per kg, whether it was compulsory in the previous period or only 'indicative' as at present. For estimating consumer prices, whole prices were converted into consumer prices by allowing 10 percent margin. The consumer prices are also calculated in Rs. 40 per kg. The export prices are average unit prices f.o.b. Karachi and calculated in Rs. 40 per kg. As regards rainfall factor, for Basmati lagged average annual rainfall at Lahore was used while in the case of IRRI, average lagged annual rainfall at Nawabshah and Hyderabad was pressed into service. Fertilizer use for rice crop was based on crop-wise percent shares estimated in the Fertilizer Use Survey (NFDC, 2005). Rice was allocated 6 percent share in this Survey. The same formula was used for calculating quantities of pesticides used.

4. Data Collection

Secondary data has been used for the study. This was collected mainly from Government of Pakistan publications such as Foreign Trade Statistics of Pakistan, annual Economic surveys, Foreign Trade of Pakistan (an EPB/TDAP publication), Agricultural Statistics of Pakistan and Pakistan Statistical Yearbook. The data on rice was also gleaned through publications and studies of the International Rice Research Institute, Manila, Food and Agricultural Organization (Rome) and Rice Research Institute in Kala Shah Kaku in District Sheikhpura.

The time-series data used pertained to the period 1990 to 2008. This covered procurement, consumer and export prices of Basmati and IRRI along with their production, acreage and yield. Time series rainfall data relating to average rainfall for sowing season (June to October) was obtained. The data for average annual availability of fertilizer was also collected for the same period.

5. Supply Response Models

Acreage models for basmati and IRRI were estimated for the three sets of prices of the two varieties.

$$\text{Model 1: } A_t = a_0 + a_1 PP_{t-1} + a_2 A_{t-1} + a_3 R_{t-1}$$

$$\text{Model 2: } A_t = a_0 + a_1 CP_{t-1} + a_2 A_{t-1} + a_3 R_{t-1}$$

$$\text{Model 3: } A_t = a_0 + a_1 XP_{t-1} + a_2 A_{t-1} + a_3 R_{t-1}$$

where:

A_t = area under rice in year t or current year (taken as dependent variable)
a_0 = constant
PP_{t-1} = lagged procurement price
CP_{t-1} = lagged consumer price
XP_{t-1} = lagged export price
A_{t-1} = lagged rice area
R_t = rainfall in sowing season.

Similarly, the following three models for yield of basmati and IRRI were estimated:

$$\text{Model 1: } Y_t = a_0 + a_1 PP_{t-1} + a_2 Y_{t-1} + a_3 F_t + a_4 PTC_t + a_5 R_{t-1}$$

$$\text{Model 2: } Y_t = a_0 + a_1 CP_{t-1} + a_2 Y_{t-1} + a_3 F_t + a_4 PTC_t + a_5 R_{t-1}$$

$$\text{Model 3: } Y_t = a_0 + a_1 XP_{t-1} + a_2 Y_{t-1} + a_3 F_t + a_4 PTC_t + a_5 R_{t-1}$$

where**:**

Y_t = yield of rice in the current year
Y_{t-1} = lagged yield of rice
F_t = fertilizer use in current year
PTC_t = pesticide use in current year
PP_{t-1} = lagged procurement price
CP_{t-1} = lagged consumer price
XP_{t-1} = lagged export price

6. Results and Discussion

6.1 Basmati Rice

The estimated acreage and yield models for Basmati Rice are presented in Table 1 and Table 2 as follows:

Table 1: Estimates of Acreage Equation

Model	Intercept	PP_{t-1}	CP_{t-1}	XP_{t-1}	A_{t-1}	R_{t-1}	R^2
Model 1	442	0.921	-	-	0.498	-0.0866	86.3
Model 2	425	-	0.115	-	0.644	-0.0910	96.1
Model 3	376	-	-	0.101	0.693	-0.1010	86

Source: Author's own calculations.

Table 2: Estimates of Yield Equation

Model	Intercept	PP_{t-1}	CP_{t-1}	XP_{t-1}	Y_{t-1}	F_t	PTC_t	R_{t-1}	R^2
Model 1	587	1.30	-	-	0.273	0.130	0.0207	-0.0342	96.5
Model 2	227	-	0.0063	-	0.809	0.123	0.0237	-0.0453	94.4
Model 3	238	-	-	0.0093	0.799	0.111	0.0243	-0.0470	94.4

Source: Author's own calculations.

In the case of acreage models for Basmati, both lagged sets of prices and lagged acreage variables are positively related to acreage of the crop while third variable of 'rainfall' is negatively related to acreage of the crop. This may be due to the fact that acreage under Basmati rice is largely canal irrigated and rain factor rather 'spoils the broth' due to excessive or untimely rains. The predictive power of the variables considered is quite strong as value of R^2 is around 86 percent (Table 1).

In the case of yield models for Basmati, yield was found positively responsive to all the three prices considered. The factor of lagged yield is also positively related to current yield of the crop. The factor of fertilizer

use is also positively related to yield in all the three models. The variable of pesticides used was also found positively related to the yield of Basmati which seems quite logical. The factor of lagged rainfall is negatively related to yield in all the three equations. This is similar to the result in the acreage models, once again highlighting 'spoiler' role of the factor. The predictive power of the variables considered is quite strong in all the three models as minimum value of R^2 is 94.4 percent (Table 2).

6.2. IRRI Rice

Tables 3 and 4 present estimated acreage and yield models of IRRI rice.

Table 3: Estimates of Acreage Equation

Model	Intercept	PP_{t-1}	CP_{t-1}	XP_{t-1}	A_{t-1}	R_{t-1}	R^2
Model 1	363	-0.201	-	-	0.580	0.177	46.0
Model 2	219	-	0.0226	-	0.701	0.185	44.6
Model 3	311	-	-	0.059	0.629	0.177	44.7

Source: Author's own calculations.

Table 2: Estimates of Yield Equation

Model	Intercept	PP_{t-1}	CP_{t-1}	XP_{t-1}	Y_{t-1}	F_t	PTC_t	R_{t-1}	R^2
Model 1	991	1.86	-	-	0.465	0.260	0.0030	0.568	88.9
Model 2	843	-	0.385	-	0.549	0.358	0.0218	0.482	88.6
Model 3	806	-	-	1.55	0.458	0.306	-0.0235	0.737	89.4

Source: Author's own calculations.

As is evident from above acreage equations for IRRI (Table 3), in the first equation, lagged acreage and lagged rainfall are found to be positively related to current acreage. The variable of lagged procurement and indicative price of IRRI is negatively related to acreage. This negative relation of IRRI rice acreage with the procurement price does place a

question mark on the efficacy of the IRRI Price Policy of the government. The predictive power of explanatory variables in the equation is not highly satisfactory as the value of R^2 is estimated at 46 percent. In the second acreage equation where consumer price was substituted for procurement price, all the three variables become positively related to the acreage. In the third equation where procurement price was replaced by export price, the relationship between export price and acreage turns negative as was seen in the first acreage equation incorporating procurement price as the price variable. The explanatory power of the variables in the last two equations at around 45 percent is again not highly satisfactory (Table3).

The results seem to suggest that acreage decision of the farmers are not influenced by both procurement and export prices of IRRI. The export prices are dictated by factors of demand and supply at the international level. But the case of procurement price of IRRI is different and places a question mark on the effectiveness of the IRRI price policy. The consumer price largely determined with the interaction of market forces does seem to be influencing acreage decision of farmers.

The predictive power in case of the three equations is quite high, ranging from 88 percent to 92 percent. The three prices are positively related to yield. The factors of lagged yield, fertilizer use and pesticide use are also positively related to yield of IRRI rice, except for the third equation where yield was regressed against export prices resulting in a negative relation between pesticide use and the yield (Table 4). The lagged rainfall factor once again turns out to be positively related to yield in all the three yield equations.

7. Conclusions and Policy Implications

The study examined supply response of both basmati and IRRI rice against three sets of prices. This was done by estimating acreage and yield equations. The following conclusions may be drawn based on the results of these equations:

1. In case of acreage equations of Basmati, all the three prices were positively related to the acreage of Basmati rice. The procurement

price however has more relevance for paddy growers as this is the price actually received by them.

2. The lagged acreage variable also turned out to be positively related to the acreage of Basmati rice. This shows that while deciding acreage to be placed under Basmati, previous year's acreage is considered by Basmati growers.

3. The factor of lagged rainfall contributes negatively towards acreage decision of Basmati growers. This applies to all acreage models of Basmati.

4. In case of the yield equations of Basmati, in addition to the three sets of lagged prices, lagged yield along with fertilizer use and pesticides were found to be positively related to yield of basmati rice. The factor of lagged rainfall is negatively related to yield in all the three equations as was also seen in case of the three acreage equations.

5. The results for IRRI yield were similar to those of basmati i.e. the yield of IRRI rice was positively related to the three sets of prices of IRRI, lagged yield of IRRI, and fertilizer use. The same was true of pesticide use factor expect in the case of third equation where export price was regressed against yield of IRRI.

6. The factor of rainfall in the three yield equations however turns positive. It seems that IRRI which is mainly grown in the Sind province and which is also partly canal irrigated, the factor of lagged rain positively influences yield of IRRI.

7. The result for IRRI acreage was however somewhat perplexing. The procurement price turned out to be negatively related to the acreage of IRRI. If we look at acreage substitution taking place between IRRI and basmati during the period under review under influence of even more rapidly increasing price of basmati, this result may well be appreciated. The IRRI acreage decreased from 44 percent of the total rice area in 1993-94 to 29 percent by the end of 2006-07. The basmati acreage, on the other hand, increased from 50 percent of the total to 62 percent during the same period.

Even other rice types gained somewhat from 6 percent of the total to 9 percent of the total during the same period. This implies that IRRI rice price Policy has lost its relevance somewhat in the case of IRRI rice. The price incentive has to be very strong for increasing acreage under IRRI rice. The lagged acreage turned out to be the most influencing factor and positively related to the IRRI acreage.

8. The rainfall factor in the case of acreage model of IRRI is positively related to acreage of IRRI as was also true for yield models of IRRI.

References

Askari, H. and J. T. Cummings 1977. "Estimating Agricultural Supply Response with the Nerlove Model – A Survey" *International Economic Review* 18(2): 257-292.

Cummings, J. T. 1975. "Cultivator Market Responsiveness in Pakistan – Cereal and Cash Crops" *Pakistan Development Review* 14(3): 261-273.

Eddie, S. M. 1971. "Farmers' Response to Price in Large Estate Agriculture in Hungary 1870 – 1913" *The Economic History Review* 24(4): 571-588.

Export Promotion Bureau: Foreign Trade Statistics of Pakistan (various Years), Government of Pakistan.

Falcon, W. P. 1964. "Farmer Response to Price in a Subsistence Economy – The case of West Pakistan" *The American Economic Review* 54(3): 580-591.

Farooq, U., T. Young, N. P. Russell and M. Iqbal 2001. "The Supply Response of Basmati Rice Growers in Punjab, Pakistan: Price and Non- Price Determinants" *Journal of International Development* 13(2): 227-237.

Federal Bureau of Statistics, Statistics Division: Pakistan Statistical Yearbook (various Years). Government of Pakistan.

Koc, A. A. 1999. *Acreage Allocation Model Estimation and Policy Evaluation for Major Crops in Turkey*. Working Paper 99 – WP 220, Centre for Agricultural and Rural Development, Iowa State University.

Krishna, R. 1963. "Farm Supply Response In India- Pakistan- A case Study of the Punjab Region" *The Economic Journal* 73(2): 477-487.

Mythili, G. 2006. *Supply Response of Indian Farmers – Pre and Post Reforms*. Mumbai: Indira Gandhi Institute of Development Research

Rezitis A. N. 2008. *Greek Beef Supply Response and Price Volatility under CAP Reforms.* Working Papers Series, University of Ioannina, Greece.

Shafiq, M. 2005. *Supply Response of Major Crops in Different Agro-Ecological Zones in Punjab*. Ph. D. Thesis, Faculty of Agricultural Economics, University of Agriculture, Faisalabad.

Stern, R. M. 1962. "The Price Responsiveness of Primary Producers" *The Review of Economics and Statistics* 44(2): 202-207.

Appendix A:

Data used for Basmati Response Models (1990-2008)

A_t	Y_t	Y_{t-1}	A_{t-1}	PP_{t-1}	CP_{t-1}	XP_{t-1}	O_t	F_t	R_{t-1}
1120	1090	1101	1105	143	322	423	1220	114	598
1065	1024	1090	1120	150	366	411	1092	113	955
1035	1086	1024	1065	155	411	448	1124	215	433
1103	1148	1086	1035	175	454	498	1267	214	422
1145	1180	1148	1103	185	467	502	1352	218	402
1148	1296	1180	1145	211	452	558	1487	251	542
1174	1372	1296	1148	222	630	701	1538	130	827
1106	1302	1372	1174	255	648	793	1439	143	1188
1216	1387	1302	1106	310	778	966	1687	139	1233
1295	1444	1387	1216	330	905	1056	1871	152	493
1158	1468	1444	1295	350	913	1002	1700	159	474
1332	1501	1468	1158	385	990	1152	1999	157	555
1377	1673	1501	1332	385	1187	1176	2304	162	536
1520	1659	1673	1377	385	1205	1190	2522	173	334
1559	1639	1659	1520	400	1300	1266	2556	222	628
1658	1761	1639	1559	415	1350	1343	2920	228	495
1589	1722	1761	1658	460	1509	1486	2736	220	652
1467	1801	1722	1589	460	2255	2361	2643	215	728
1697	1710	1801	1467	460	3107	3364	2901	223	654

Source: 1. Federal Bureau of Statistics, Statistics Division, Government of Pakistan: "Foreign Trade Statistics of Pakistan" (various years)
2. Export Promotion Bureau, Government of Pakistan: "Foreign Trade of Pakistan" (various years)
3. Economic Advisor's Wing, Finance Division, Government of Pakistan: "Pakistan Economic Survey" (various years)
4. Economic Wing, Ministry of Food, Agriculture and Livestock, Government of Pakistan: "Agricultural Statistics of Pakistan" (various years)

Table 2: Data used for IRRI Supply Response Models (1990-2008)

At	Y_t	PP_{t-1}	CP_{t-1}	XP_{t-1}	F_t	R_{t-1}	A_{t-1}	Y_{t-1}	O_t
879	2217	73	192	193	113	173	830	2208	1949
803	2239	78	214	215	215	17	879	2217	1798
961	2627	85	239	207	214	390	803	2239	2524
865	2226	90	231	239	218	36	961	2627	1927
895	2550	103	200	320	251	501	865	2226	2284
952	2656	112	429	315	130	147	895	2550	2493
952	2592	129	388	347	143	18	952	2656	2468
988	2623	153	433	418	139	49	952	2592	2593
1015	2867	175	601	396	152	191	988	2623	2912
926	2759	185	423	347	159	12	1015	2867	2556
667	2539	205	401	412	157	49	926	2759	1694
722	2690	205	453	412	162	114	667	2539	1942
718	2648	205	465	487	173	8	722	2690	1901
678	2816	215	549	524	222	313	718	2648	1908
750	2952	230	619	561	228	84	678	2816	2214
756	2959	300	623	612	220	26	750	2952	2238
747	3058	310	959	1151	215	399	756	2959	2284
915	3261	310	1494	1604	223	243	747	3059	2984

Source: 1. Federal Bureau of Statistics, Statistics Division, Government of Pakistan: "Foreign Trade Statistics of Pakistan" (various years)
2. Export Promotion Bureau, Government of Pakistan: "Foreign Trade of Pakistan" (various years)
3. Economic Advisor's Wing, Finance Division, Government of Pakistan: "Pakistan Economic Survey" (various years)
4. Economic Wing, Ministry of Food, Agriculture and Livestock, Government of Pakistan: "Agricultural Statistics of Pakistan" (various years)

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Role of Tunnel Technology in Transforming Traditional Agriculture: A Case Study of Districts Sheikhupura and Nankana Sahib

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Abstract: This study analysed the factors which affected the adoption of tunnel technology in districts Sheikhupura and Nanakana Sahib. The study revealed that age, education and landholding of the farmers are very significant determinants of the adoption of tunnel technology while off-farm income and market distance from the farm are not statistically significant. Government should provide extension services and subsidy to the farmers, especially to small landholders. This will accelerate the process of diffusion of tunnel technology which will transform traditional agriculture into a modern sector, leading to the economic development.

Keywords: Tunnel Technology, Agriculture
JEL Classification: 031, O3

1. Introduction

Agriculture is an important sector for almost all developing countries. Its role in economic development is vital because most of the people in poor countries make their living from land. The size of this sector gives it a significant position in the economy. Although the developing countries have been pursuing development for many decades, there still remains a space between actual productivities and what is technically viable through the application of modern knowledge, especially in agriculture. This means that limitations imposed on agriculture by fixed supply of land can be counterbalanced by progress in biological and mechanical technologies. Therefore, for an economy to develop, transformation of agriculture from traditional to modern is of paramount importance.

Developing countries are facing the problem of insecure supply of food and many of them are agrarian economies. There is a need to facilitate the diffusion of modern scientific knowledge and technological advancements

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in those economies which are still relying on pre-scientific means of farming and crop growing in a scientific world.

The introduction of a technology that transforms agriculture will lead towards change as it was observed in the case of Green Revolution of the late 1960s and early 1970s when considerable increase in the per acre yield of some major crops such as wheat and rice was noticed in many countries such as Mexico, India, Pakistan and Thailand.[1]

Tunnel technology uses plastic in agriculture for the cultivation of crops through environmental modifications. It is advantageous in many ways. First, it makes early crop production a possibility. Second, it guarantees higher per hectare yield. Third, it makes efficient use of water and fertilizers and reduces soil and wind erosion. And finally, it decreases the possibility of low crop yield in case of diseases (Lamont, 2005).

The Roman emperor Tiberius Ceasar (who ruled between 14 and 37 A.D.) was reportedly told by his doctor that he needed a cucumber a day. He made arrangements to produce them throughout the year. The discovery and development of polythene polymer in late 1930s made it possible to form greenhouses with plastic material. At present, high tunnels and plastic greenhouses cover over 21 billion square feet of land around the world; China, Japan and Korea account for 50 percent of this area.

Tunnel technology works on the principle of greenhouse farming by increasing the temperature inside the tunnel. Due to the increased temperature, speedy photosynthesis takes place and the crop becomes ready before time. Thus, farmer gets the benefit of it as the price of the off-season farm output is usually higher than the price of in-season output due to lesser supply and higher demand for it. With the availability of high quality hybrid seeds, the surplus production through tunnel technology can be exported as well. This technology allows early plantation and it also leads to faster growth of the plants. It reduces water evaporation from the soil and increases the per hectare yield by many times, depending on the inputs used for the production. Different studies have proven that the use of plastic mulches is beneficial in many ways.

[1] Ghatak (1987)

The study of the Indian Council of Agricultural Research (ICAR) in the North Eastern Hill Region of India on the plastic mulch's benefits revealed that use of plasticulture technologies increases production as compared to outdoor plot cultivation (Singh and Satapathay, 2009). Another study by the Southwest Research and Outreach Center (SWROC) of United States on the comparison of season extension and high yield in the high tunnel proves that tunnel farming is far better than outdoor plot cultivation (Belina and Nichel, 2009).

According to Ghatak (1987), the transformation of traditional agriculture undergoes following three stages:

1. Subsistence Farming
2. Mixed Farming
3. Commercial Farming

First stage is subsistence farming. The reason for subsistence farming in many poor countries is the lesser use of modern technical inputs. Transformation process spreads the application of advancement in knowledge to the productive system which leads to the second stage of transformation where surplus in production takes place. Second stage of the transformation dominates in the absence of developed institutional infrastructure. Commercial farming starts with the development of appropriate economic and political institutions. Tunnel technology can generate four important benefits which can help in transforming the traditional agriculture:

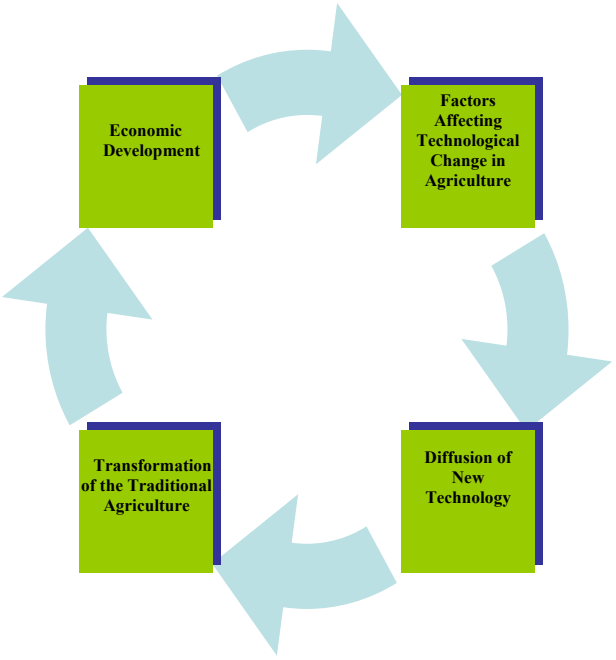
1. It can increase the supply of food for domestic consumption
2. It can enlarge the size of the market for industrial output
3. It can increase the supply of domestic savings
4. It can help earning valuable foreign exchange

Keeping in view its benefits, plasticulture has been introduced in Pakistan and it is being promoted in order to take utmost gains of it for vegetable and fruit production to: 1) attain higher yield; 2) avoid soil and wind erosion; 3) ensure early crop production; and 4) gain foreign exchange.

At the government level, the promotion of this technology was started by Pakistan Agriculture Research Council (PARC) and then the provincial

departments of agriculture took on this responsibility. The agriculture department of the Government of Punjab started programmes to promote and diffuse this technology. Two extension programmes were started by the agriculture department of Punjab. The first extension programme was launched in 2005 with the name of "Food and Vegetable Development Project Punjab (2005-10)." Under this programme the Farmer Field Schools (FFS) were established and farmers were trained to get acquainted with tunnel technology. The second programme was started in 2008 and its name was "Promotion of Tunnel Technology for Vegetable Production (2008-10)." The purpose of this programme was to provide subsidy to the farmers for the construction of tunnels.

Figure 1: Factors Affecting Adoption of Tunnel Technology



Source: Authors' own compilation.

Pakistan is facing the problem of population surge and inadequate food supply. Resultantly, it requires efficient allocation of its productive resources if it wants to produce surpluses for its rising population. The evidence shows that per acre yield of land has declined in Pakistan. Technological backwardness is one of the reasons behind agricultural

impoverishment. The knowledge of the factors that determine the diffusion of a technology is necessary to any deeper understanding of the process of economic growth. The diffusion of a technology in a society is a crucial, critical and complex process, especially in agriculture and it involves many economic and non-economic variables. For the rapid diffusion of a technology the behaviour of these factors require proper assessment and their effect on the diffusion of a technology needs measurement.

This study examines the factors that have affected the adoption of tunnel technology in districts Sheikhupura and Nankana Sahib. Agriculture is the backbone of these districts, providing a major source of employment for the labor force. These districts are irrigated through a number of canals with rice being the main crop but vegetables are also grown. Tunnel technology is being used in these districts since its introduction. The principle objectives of this study are to examine the factors affecting the diffusion of tunnel technology and to assess the role of this technology in transforming the agriculture sector of Pakistan. Another goal is to find out the ways in which government can play its role in promotion of tunnel technology.

Section 2 of the study is based on the review of the literature regarding role of agriculture in economic development and how different studies have explained the characteristics of the transformation process of traditional agriculture. Section 3 explains data and methodology while Section 4 is based on empirical results and analysis. Section 5 deals with the conclusion and policy implications.

2. Literature Review

Agriculture, in general, is the primary sector of the poor countries' economy. Various studies have examined the role of agriculture in economic development and assessing the characteristics of the transformation process of traditional agriculture.

Solow (1957) made estimates of an aggregate production function of United States, for the period between 1909 and 1949, based on capital and labour quantified in such a way that neither was even slightly linked to the stream of services produced by real capital and real labour. Later, he

claimed that the production of new capital goods works as a "carrier" of new scientific and technological knowledge. Hayami and Ruttan (1985) also estimated their production function, pooling the cross-section data of 44 countries for three time periods (1960; 1970; 1980). They found that nearly half of the differences in labour productivity, in three low-income countries, relative to the United States were due to differences in the use of technical inputs and investment in human capital.

The role of agriculture in the economy was analysed by Kuznets (1961) who concluded that developed agriculture can make four kinds of contributions to an economy – a 'product' contribution, a 'factor' contribution, a 'market' contribution, and a 'foreign exchange' contribution. Therefore, its role in economic development is vital. Similarly, Johnston and Meller (1961) stated that agriculture can contribute to the economic development by providing increased food supplies, by enlarging agricultural exports, by transferring of manpower from agriculture to non-agricultural sectors, by contributing to capital formation and by increasing rural net cash income which serves as a stimulus to industrialization.

The efficiency of the traditional agricultural system was examined by Killick (1981) and Ghatak (1987) in their respective studies. They opined that traditional agriculture is statically efficient but dynamically inefficient and the reason for this is technological stagnation. Technological backwardness is one of the reasons behind agricultural impoverishment in developing countries. Alternatively, technological advancement lowers the average per unit cost of production because the productivity of all or some of the inputs increases, giving larger output from an unchanged spending on inputs. Similar argument was made by Schultz (1964), who presented his 'high-payoff input model'. This study implied three kinds of reasonably high payoff investments for agricultural development: 1) the capacity of agricultural research institutions to generate new location-specific technical knowledge; 2) the capacity of the technology supply industries to develop, produce and market new technical inputs; and 3) the schooling and non-formal (extension) education of rural people to enable them to use new knowledge and technology efficiently.

Agricultural development has also been found to lead to increased food supplies and higher rural income to increase the markets for urban output (Timmer, 1988; Ruttan, 2002; Alston *et al.,* 2006). It also provides resources to expand the urban output. Technical change is the basis of growth and productivity in the long run, since investment in traditional technology immediately faces low marginal returns. Also, growth in total factor productivity in agriculture due to technological progress has made an increasingly significant contribution to economic uplift. The decline in the food prices is the single most important factor (in many parts of the world) determining the buying power of wages. Self and Grabowski (2007) contested that technology developed to support agricultural growth plays a vital role in overall growth of the economy. It does so through two main channels: (1) a direct effect that relates to benefits obtained by technology adopters, and (2) an indirect effect through gains in productivity, increased production, and lower prices.

Omonona et al. (2005) examined various factors influencing the adoption of improved cassava varieties and its impact on the welfare of rural farmers in Edo State, Nigeria. The Tobit regression model was used to determine depth and severity of poverty among farming households who are adopters and non-adopters of improved cassava varieties. The results showed that sex, age, access to extension agents, access to inputs, and crop yield are significant variables positively influencing adoption of improved cassava varieties. Similarly, Nin-Pratt *et al.* (2009) pointed towards an essential range of policies and investments that are needed to fuel growth of productivity. These include the following: development of opportunities for regional cooperation on technology adaptation and diffusion, strengthening regional agricultural markets exploiting opportunities for greater regional cooperation and harmonization, diversification of traditional markets, and enhancement of linkages between agricultural and non-agricultural sectors.

3. Data and Methodology

This section explains the data sources, specifications of the model and methodology used for analysis.

3.1 Data Description and Variables

The primary data used in this study was collected from districts Sheikhupura and Nankana Sahib of Punjab. These two districts comprise of a total of 8 *tehsils* (sub-districts) and the sample of 250 farmers was taken from among the farmers who have adopted tunnel technology. Variables were chosen in accordance with the economic theory. Different studies reveal that age, education, farm size, market distance and income of the farmer are some of the important factors which determine the adoption of a new technology by the cultivator (Welch, 1970; Heibert, 1974; Killick, 1981; Ghatak, 1987; Timmer, 1988;).

3.2 Methodology and Model Specification

The exact number of farmers who have adopted the tunnel technology was not known. So, the following statistical formula was used to draw the sample size:

$$n = \frac{Z^2 * V^2}{e^2}$$

where

n = Sample size
Z = Normal variant at 95 percent precision level
V = Guessed variability among sampling units i.e. 50 percent for obtaining maximum sample size
e = Accepted error i.e. up to 10 percent.

Putting these values in equation

$$n = \frac{(1.96)^2 * (50)^2}{(6.2)^2} = 249.8 \text{ or } 250.$$

3.2.1 Universe of the Study

Multiple stage sampling method was used to draw the sample. At first stage two districts were selected i.e. Shiekhupura and Nankana Sahib.

Equal weightage was given to each *tehsil* of these districts. Sheikhupura has 5 *tehsils* while Nankana Sahib has 3. So, 62.5 percent (156) sample was collected from district Sheikhupura and 37.5 percent (94) sample was collected from district Nankana Sahib. From each *tehsil,* 31 samples were drawn by dividing each *tehsil* into two subunits i.e. 15 from one sub-unit and 16 from other on the basis of random selection.

Given the nature of the data, following model is specified:

$$ATT = \beta_{0+} \beta_1 (Age) + \beta_2 (PE) + \beta_3 (ME) + \beta_4 (SE) + \beta_5 (HSE) + \beta_6 (HE) + \beta_7 (SLHb) + \beta_8 (MLH) + \beta_9 (LLH) + \beta_{10} (OFI) + \beta_{11} (MD)$$

where

ATT = Adoption of Tunnel Technology
= Percentage of total land to land planted under tunnel technology at farm level.
Age = Age of the respondents (years).
PE = Primary Education equals to 5 years of formal education.
= 1, for Primary Education; 0 otherwise
ME = Middle Education equals to 8 years of formal education
= 1, for Middle Education; 0 otherwise
SE = Secondary Education equals to 10 years of formal education
= 1, for Secondary Education; 0 otherwise
HSE = Higher Secondary Education equals to 12 years of formal education
= 1, for Higher Secondary Education; 0 otherwise
HE = Higher Education is greater than equal to graduation.
= 1, for Higher Education; 0 otherwise
SLHb = Small Landholding (b) is between 6.25 - 12 acres.
= 1, for Small Landholding (b); 0 otherwise
MLH = Medium Landholding is between 12 - 25 acres.
= 1, for Medium Landholding; 0 otherwise
LLH = Large Landholding is above 25 acres of Landholding.
= 1, for Large Landholding; 0 otherwise
OFI = Off-Farm Income
= 1, for Off-Farm Income; 0 otherwise

MD = Distance from Market (Kilometers)

The primary data on these variables was collected from the farmers who have adopted tunnel technology. Ordinary Least Square (OLS) method was used to measure the relationship between dependent and independent variables. The dependent variable i.e. adoption of tunnel technology, was measured by dividing the landholding of a farmer under the tunnel over his total landholding. This is in accordance with the study of Gafsi and Roe (1979) who used this method to measure the adoption of new wheat varieties in Tunisia.

4. Empirical Results and Analysis

The regression equation is as follows:

$$\begin{aligned} ATT = {} & 2.407 + 0.198\ (Age) - 0.511\ (PE) + 0.08\ (ME) + \\ & 3.931\ (SE) + 0.463\ (HSE) + 3.552\ (HE) - 2.187 \\ & (SLHb) + 1.895\ (MLH) + 12.398\ (LLH) + 2.053 \\ & (OFI) - 0.069\ (MD) \end{aligned}$$

The parameter estimates of the age of the farmer, middle education, secondary education, higher secondary education, higher education, medium landholding, large landholding and off-farm income are positive indicating that they are positively related to the adoption of tunnel technology. On the other hand, the coefficients of primary education, small landholding and market distance are negatively related to the adoption of tunnel technology. The results are presented in Table 1.

4.1 Age

The parameter estimate of the age of the farmer is significant at 5 percent level of significance and has positive sign, as expected, indicating that the experience, defined as learning by doing, of the farmer increases with the age and his ability to analyse information increases. It means that one unit increase in the age of farmers adopting tunnel technology increases the adoption rate by 0.198 percent. The perceived distribution of technical constraints changes over time from lower payoff to a higher payoff. Thus,

the likelihood of adopting better technology increases. This result is in line with the findings of Heibert (1974).

4.2 Education

The coefficient of the first dummy of education, i.e. primary education, has negative sign which indicates that adoption rate is inversely related to it. It states that mean adoption rate of the farmers having primary education is 1.896 percent (i.e. $\beta_0 + \beta_2$). Farming in tunnels is a complex technique and it demands exposure to the technology. That is the reason why farmers having primary education are hesitant to adopt it. But the dummy for primary education is not statistically significant in the model.

Table 1: Parameter Estimates

Parameter Estimates	Coefficients		T-statistic	Sig.
	β	Std. Error		
(Constant)	2.407	4.811	0.500	0.617
Age	0.198	0.089	2.219	0.027
PE	- 0.511	2.213	- 0.231	0.818
ME	0.080	2.333	0.034	0.973
SE	3.932	2.178	1.805	0.072
HSE	0.463	1.997	0.232	0.817
HE	3.552	2.178	1.631	0.097
SLHb	- 2.187	2.377	- 0.920	0.359
MLH	1.895	1.796	1.055	0.293
LLH	12.398	1.723	7.196	0.000
OFI	2.053	1.266	1.622	0.106
MD	- 0.069	0.067	- 1.040	0.299
	R^2 = 0.309	$R^{\wedge 2}$ = 0.277	F = 9.686	DW = 1.720

Source: Authors' own calculations.

The coefficient of middle education, though statistically insignificant in the model, is positively related to the adoption of tunnel technology. This surely implies that increase in human capital through formal education helps in the acceleration of the process of diffusion. It indicates that mean adoption rate of the farmers having middle education is 2.487 percent (i.e. $\beta_0 + \beta_3$).

The parameter estimate of secondary education is directly related to the adoption of the tunnel technology and the result is statistically significant at 10 percent level of significance. The coefficient of secondary education equals 3.932 which means that mean adoption rate of the farmers having secondary education is 6.339 percent (i.e. $\beta_0 + \beta_4$).

The parameter estimate for higher secondary education is 0.463 which states that mean adoption rate of the farmers having primary education is 2.407 percent (i.e. $\beta_0 + \beta_5$). This variable is also statistically insignificant. The reason for the lower impact of higher secondary education than secondary education is that the farmers pursue higher education once they acquire higher secondary education and move to the nearest town or city. Normally, they join their farm after getting secondary education.

The coefficient for higher education is significant at 10 percent level of significance and it is positively related to the adoption of tunnel technology. It implies that the mean adoption rate of the farmers having higher education is 5.959 percent (i.e. $\beta_0 + \beta_6$). The reason for a higher adoption rate of the farmers having higher education is mainly their graduation in agriculture sciences.

These results are consistent with the study by Ram (1976) and Rozenweig (1978) which conclude that farmers with better education are early adopters of new technological inputs and apply modern inputs more efficiently throughout the adoption process.

4.3 Landholding

The coefficient of small (b) category of landholding reveals that mean adoption rate of the farmers having small (b) category of land is 0.22

percent (i.e. $\beta_0 + \beta_7$). Though it is statistically insignificant yet it suggests that there is a negative correlation between small (b) landholdings and the adoption of tunnel technology. The reason for it is that small landholdings are often uneconomic. Due to subsistence farming, small farmers do not have enough to save. Moreover, they do not have an easy access to formal credit institutions either. Thus, they do not go for new technology.

The coefficient of middle category of landholding indicates that although statistically insignificant, there is a positive relationship between the rates of adoption of tunnel technology and middle landholding. It states that the mean adoption rate of the farmers having middle level farm size is 4.302 percent (i.e. $\beta_0 + \beta_8$).

The coefficient of large landholding is perfectly significant at 1 percent level of significance. It shows that there is a positive relationship between large landholdings and the adoption process. The result states that the mean adoption rate of the farmers having large landholding is 14.805 percent (i.e. $\beta_0 + \beta_9$) which means that the large landholders adopt tunnel technology at a rapid pace during the early stages of the diffusion process. These conclusions are supported by Weil (1970) and Parthasarathy and Prasad (1978) who suggest that large capital costs decrease the tendency to adopt and thus, slow the rate of adoption by small farmers.

4.4 Off-Farm Income

The coefficient of the off-farm income points out that there is a positive correlation between adoption of tunnel technology and the off-farm income of the farmer. The result states that the mean adoption rate of the farmers having off-farm income is 4.46 percent (i.e. $\beta_0 + \beta_{10}$) although it is statistically significant at almost 10 percent level of significance.

4.5 Market Distance

The coefficient of the distance from the market shows that there is a negative correlation between adoption of tunnel technology and the distance from the market. Though the result is statistically insignificant yet it states that one percent increase in the distance of the farm from the market, on average, decreases the adoption rate by .069 percent. This result is in line with the findings of Ahmed and Chaudhry (2001).

The R^2 value is 0.309 while adjusted R^2 is 0.277. Given the primary nature of data, these results are reasonable. The value of F-Test is also significant which implies that the model is overall statistically significant. Durbin-Watson test shows that there is no positive or negative autocorrelation among variables.

5. Conclusions and Policy Implications

5.1 Conclusions

For economic development of a country, the transformation of its agriculture sector from traditional to modern, knowledge-based one is essential. The backwardness of agricultural technologies is one of the major impediments in the path of their development. The introduction of new and advanced technologies is a necessary ingredient as it enables the country to cater to the needs of the growing population.

Tunnel technology can enhance agricultural production. Its role in transforming traditional agriculture is critical as along with increasing the output it can change the market structure. It has another advantage of reducing seasonal unemployment in the agriculture sector as it ensures year round cultivation and thus generates employment during the whole year. This may lead to a surplus output, which can be exported to generate foreign exchange.

The analysis reveals that the age, education and farm size of the cultivator play a very significant role in his decision of adopting tunnel technology while the off-farm income and distance from the market are less significant but important determinants in this regard. These results can be generalized to explain the patterns of adoption of new technologies in the agriculture sector of Pakistan.

The government has a vital role in ensuring the rapid adoption of a technology in any country. The study reveals that only 12 percent of the farmers, who have adopted tunnel technology, got assistance from a formal credit agency. The government must provide adequate microfinance services to the farmers in order to accelerate the diffusion of tunnel technology.

5.2 Policy Implications

Tunnel technology is an efficient mean of crop cultivation and its adoption at a large-scale can help develop the agriculture sector of Pakistan. Role of government is of ample significance in this regard as its policies can affect the factors that influence agricultural transformation. Similarly, it can provide "flexible rural institutions" which can generate higher material rewards for the farmers (Timmer, 1988).

5.2.1 Education

The impact of education on the adoption of tunnel technology is positive. Educated farmers are utilizing this technology effectively due to greater information and exposure. Government must initiate an extension programme for the tunnel technology at a much larger scale. An extension programme was initiated by the Government of Punjab in 2005 but it was on a small scale. Farmer training institutes must be developed so that farmers get acquainted with this technology. This will trigger the adoption process in the right direction.

5.2.2 Research and Development

The availability of locally developed, low-cost, hybrid seed varieties will reduce the cost of production and thus, the adoption of tunnel technology will take place at a rapid pace. Moreover, research should also be conducted on the cultivation of other crops under the tunnels as, at present, only 7 to 8 crops are being cultivated using tunnel technology.

5.2.3 Provision of Targeted Subsidy

It is evident from the results that the large landholders are the early adopters of new technology. It implies that they are getting the benefits of higher prices prevailing in the market for the off-season crops. This unequal distribution of income will increase the gap between rich and the poor and it will adversely affect the nature of rural society. Government must subsidize the adoption of tunnel technology for the smaller farms. Previously, a subsidy programme was launched but it was 'open for all'. Government's subsidy should be directed towards the small farms. This

will aid the adoption of tunnel technology and will also address the issue of equity in distribution of income.

5.2.4 Land Consolidation

The law of inheritance results in division of large landholdings into smaller ones. Thus, economic holdings are being converted into uneconomic holdings. These subsistence farms are an impediment to the adoption of tunnel technology. Government should introduce a system of land consolidation in which farmers should work in cooperation. This will not only increase the productivity of land but also help the diffusion of tunnel technology.

5.2.5 Provision of Micro-Financing

Off-farm income is also positively correlated to the adoption of tunnel technology meaning that those who do not have income sources other than the farms are hesitant to employ this new mechanical technology. Government's policy response must facilitate such farmers. Provision of micro-financing institutions and other credit agencies at the door step of the farmers may serve as an effective tool in this regard. The ease of access to these institutions will definitely help in transforming the agriculture sector.

5.2.6 Infrastructural Support

Market distance has a negative correlation with the adoption of tunnel technology. Government should provide infrastructural support to the farmers in building road networks from farms to the markets. This can help the spread of tunnel technology. It is a fact that the farm output is perishable and distant markets can prove disastrous for the farmers. Therefore, government must invest in the provision of better storing and packaging facilities for the farmers.

5.2.7 Promotion of Other Plasticulture Technologies

Maximum gains can be attained if government supports other plasticulture technologies along with tunnel technology. If plastic material is used for

irrigation, chemigation, fertigation, and packaging along with cultivation, then maximum advantages (greater yield and increase in life time of the product) can be obtained.

5.2.8 Search for New Export Markets

With the increase in supply of agricultural produce, government should find new international markets for its agricultural surplus. Resultantly, farmers will receive higher prices and government will earn valuable foreign exchange.

References

Ahmed, M. and G.M. Chaudhry 2001. "Factors in Farm Level Fertilizer Demand in Irrigated Pakistan" *Pakistan Society of Development Economists*, 16th Annual General Meeting (January 22-24).

Alston, J. M., K. J. Bradford and N. Kalaitzandonakes 2006. "The Economics of Horticultural Biotechnology" *Journal of Crop Improvement* 18 (1&2): 413 – 431.

Belina, K. and L. Nichel 2009. "First Year of Organic Vegetable Production" On Web: http://swroc.cfans.umn_edu/organic/SWROCHightunnel/pdf

Gafsi, S. and T. Roe 1979. "Adoption of Unlike High-Yielding Wheat Varieties in Tunisia" *Economic Development and Cultural Change* 28(1): 119-133.

Ghatak, S. 1987. Agriculture and Economic Development. In: Normell, G. ed. *Surveys in Development Economics*. Basil Blackwell Ltd.: London.

Hayami, Y. and V. W. Ruttan 1985. *Agricultural Development: an International Perspective*. Baltimore: Johns Hopkins University Press.

Heibert, D. 1974. "Risk, Learning and the Adoption of Fertilizer Responsive Seed Varieties" *American Journal of Agriculture Economics* 56(November), 764-768.

Johnston, B.F. and J.W. Meller 1961. "The Role of Agriculture in Economic Development" *The American Economic Review* 51(4): 566-593.

Killick, T. 1981. *Policy Economics*. London: Heinemann Educational Books Ltd.

Kuznets, S. 1961. "Economic Growth and the Contribution of Agriculture: Notes on Measurement" *International Journal of Agrarian Affairs* 3(2): 56-75.

Lamont, W.J. 2005. "*Vegetable Production using Plasticulture*" on web: http://www.agnet.org/library/eb/476/.

Lemmon, K. 1963. *The Covered Garden*. Philadelphia: Dufour

Nin-Pratt, A., M. Johnson, E. Magalhaes, X. Diao, L. You and J. Chamberlin 2009. "Priorities for Realizing the Potential to Increase Agricultural Productivity and Growth in Western and Central Africa" IFPRI Discussion Paper 00876. On Web: www.ifpri.org

Omonona, B.T., O.A. Oni and A.O. Uwagboe 2005. "Adoption of Improved Cassava Varieties and Its Welfare Impact on Rural Farming Households in Edo State, Nigeria" *Journal of Agricultural and Food Information* 7(1): 39-55.

Parthasarathy, G. and D.S. Prasad 1978. *Response to the Impact of the New Rice Technology by Farm Size and Tenure: Andhra Pradesh, India*. Los Banos: International Rice Research Institute

Ram, R. 1976. *Education as a Quasi Factor of Production: The Case of India's Agriculture* Ph.D. Dissertation, University of Chicago.

Rozenweig, M.R. 1978. "Schooling, Allocative Ability, and the Green Revolution" Paper presented at the meeting of Eastern Economic Association, Washington, D.C.

Ruttan, V.W. 2002. "Productivity Growth in World Agriculture: Sources and Constraints" *The Journal of Economic Perspectives* 16(4): 161-184

Schultz, T.W. 1964. *Transforming Traditional Agriculture*. New Haven, Conn: Yale University Press.

Self, S. and R. Grabowski 2007. "Economic Development and the Role of Agricultural Technology" *Agricultural Economics* 36(3): 395–404.

Singh, R.K. and K.K. Satapathy 2009. "*Scope and Adoption of Plasticulture Technologies for Enhancing Production in North East*

Hill Region" On Web: http://gbpiled.gov.in/envis/HTML/vol15-1&2/rksingh.htm

Solow, R.M. 1957. "Technical Change and the Aggregate Production Function" *Review of Economics and Statistics* 39(3): 312-319.

Timmer, C.P. 1988. The Agriculture Transformation. In: Chenery H. and T.N. Srinavasan ed. *Handbook of Development Economics*. North Holland Publishing Company: Amsterdam.

Weil, P.M. 1970. The Introduction of Ox Plow in Central Gambia. In: McLaughlin P. F. ed. *African Food Production Systems: Cases and Theory*. John Hopkins University Press: Baltimore.

Welch, F. 1970. "Education in Production" *Journal of Political Economy* 78(January/February): 35-59.

Wittwer, S.H. 1993. "World-wide Use of Plastics in Horticultural Production" *Hort Technology* 3(1): 6-19.

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Learning-by-doing and Cost Structure of Pakistan's Manufacturing Sector

Jamshaid-ur-Rehman*

Abstract: The study focuses on the measurement and analysis of cost structure of Pakistan's manufacturing sector, by isolating the contribution of learning-by-doing through learning curve. The analysis of log-linear learning curve suggests that learning rate in manufacturing sector is 27.7 percent i.e. for every 1 percent increase in cumulative output (experience), on average, the average cost decreases by 27.7 percent. On the contrary, the combined effect of learning and scale economies in a regression line revealed that learning rate has considerably increased to 61 percent, which suggest that learning-by-doing phenomenon is very strong in Pakistan's manufacturing sector.

Keywords: Cost Structures, Manufacturing Sector
JEL Classification: 060, L6

1. Introduction

The historical applications of the cost and learning curves have been documented well by Scherer (2001) and Yelle (1979), respectively. The cost is important for almost all fields of production e.g. corporations, economic enterprises, government cost estimation organizations etc., due to its perceived benefits for competitors in the same market (Besanko *et al.*, 2004). On the other hand, learning curve shows a decrease in average costs per unit when cumulative production level rises. The learning curve received special attention during World War II, as attempts were made to predict costs and time required for manufacturing ships and aircrafts for warfare (Wright, 1936). Similarly, studies conducted in the post-war era often used cost or price per unit instead of direct labour hours (Middleton, 1945; Crawford and Strauss, 1947; Carr, 1946; Asher, 1956).

The theoretical as well as empirical literature signifies a strong relationship between cost and learning curves (Yelle, 1979; Roberts, 1983; Thomas and Dutton, 1984; Argote and Epple, 1990). The cost

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minimization through learning process, attributed to experience, has been the focus of many studies (Conway and Schultz, 1959; Hirsch, 1952; Sheshinski, 1967; Thomas and Dutton, 1984; Becker and Baloff, 1969; Abernathy and Baloff, 1973; Muth, 1986). It suggests that as a product is produced over and over, the time and cost needed for its production decreases in a pattern that is exponential in nature (Wright, 1936; Alchians, 1963; Yelle, 1979; Thomas and Dutton, 1984; Searle and Goody, 1945). This type of learning captures the traditional learning-by-doing phenomenon (Adler and Kim, 1991).

A number of earlier studies have analysed the cost functions in Pakistan. A study related to Generalised Leontief cost function was conducted by Ahmad and Idrees (1999), which analysed the effect of technology on unit cost of production in Pakistan's manufacturing sector. It computed annual percentage change in unit cost, assuming output and prices as constants, and concluded that the unit cost would increase at an average rate of 0.04 percent. By applying the translog cost function, Khan and Burki (2000) showed that the manufacturing sector of Pakistan does not minimize costs subject to market prices and the evidence of allocative inefficiency. Similar studies, based on the translog cost function, have been conducted by Mahmood (1989; 1992) and Chishti and Mahmud (1988; 1991). Burki *et al*. (1997) applied the parametric model and found strong indication of inefficiencies in the allocation of resources in the manufacturing sectors of both India and Pakistan.

The focus of this study is to examine the cost trends in Pakistan's manufacturing sector via learning curve. The theoretical literature suggests several possible shapes[1] of learning curves but the focus of this study will be on the log linear model for cost. In this regard, this study examines various aspects of labour learning in Pakistan. The objectives of the study are two-fold: First, it investigates the gains in manufacturing experience with respect to the decrease in unit cost of production due to increased knowledge. Second, it identifies average cost reduction in manufacturing sector of the learning economies and/or scale economies.

[1]Yelle (1979)

The organization of this study is as follows: Section 2 describes the methodology and design of the learning curve, results obtained and their performance evaluation. Section 3 draws conclusions from the results and provides policy recommendations.

2. Methodological and Estimation Issues

The study uses aggregate average cost trends, through learning curves, in the manufacturing sector of Pakistan for the period 1955 to 2005. In Pakistan, the primary source of manufacturing data is the Census of Manufacturing Industries (CMI), conducted by the Federal Bureau of Statistics, which is available for most of the years since 1955. For the years in which CMI were not conducted the series was interpolated. The data for capital input has been borrowed from Wizarat (2003), where the details regarding computation of this variable have been discussed.

The learning curve for cost is of two types; First, it comprises the conventional power function of learning curve, to explicitly identify the learning rate, learning index, and the progress ratio of the manufacturing sector of Pakistan. Second, it augments the conventional learning curve with cost drivers,[2] such as, wage rates, energy cost, raw material cost, capital stock in manufacturing (as a proxy of capacity utilization) and vertical integration, in order to unequivocally identify scale economies and learning curve economies, simultaneously.

2.1 Estimation of Cost Learning Curve

The study uses regression analysis to estimate the learning curve for costs. Instead of total cost, average cost, has been used because learning curve with average cost declines with cumulative experience. The first year's output/production with cumulative experience will enable the firm to enter next year of production with cumulative output. This helps in moving down the learning curve, so a firm enjoys lower average cost in the second year of production. The level of average cost falls with cumulative experience across several years. Thus, experience in the previous years

[2] Cost Drivers are the basic economic forces that cause variations in costs across different organizations/firms.

enables the firm to revamp its production techniques. It has added advantage, that is, it is a do-it-yourself technique which makes sense to those who are the subject of its application.

In the words of Argote and Epple (1990) "Standard measure of organizational experience in the learning curve formulation is the cumulative number of units produced, a proxy variable for knowledge acquired through production. If unit costs decrease as a function of this knowledge, other variables being equal, organizational learning is said to occur."

Hence, the cost learning curve of Pakistan's manufacturing sector follows the conventional power function given by Wright (1936) and has been well documented by Yelle (1979):

$$AC_t = \alpha\, CQ_t^{\psi}$$

This can be converted into the log-linear form as in equation (1) below:

$$\ln AC_t = \alpha + \psi \ln CQ_t + \varepsilon_t \qquad (1)$$

where

AC =	average cost
CQ =	cumulative production volume
α =	average cost required to produce the first unit or the intercept
ψ =	$log\ \Phi / log\ 2$ = referred to as the 'learning index'
Φ =	the 'learning rate' of cost
$1 - \Phi$ =	the 'progress ratio' of cost

Logarithm is used in the preceding equation for two reasons: first, to measure the estimated coefficients as elasticities and second, to make a suitable transformation of the exponential learning curve, so that it can be best estimated by ordinary least square. The resultant estimated equation (equation 1) is reported in Table 1. Although the initial equation [without AR(1)] gives the right sign of the slope coefficient along with its

significance, the overall fit of the model is not good, suggested by the very low value of the R^2 (0. 2414). Moreover, the residuals also have a severe case of serial correlation, as depicted by the very low value of Durban-Watson test (0.1599), suggesting that there is first order autocorrelation problem. Consequently, the study uses the first order autoregressive iterative technique to remove autocorrelation (last column), which leads to an improvement in the results. Moreover, the value of learning index has increased from 0.3715 to 1.8518. These improved results give more likelihood of obtaining reliable results of the rate of learning as well as the progress ratio in the manufacturing sector of Pakistan. Hence, to identify these two values, the study uses the following calculations:

The log of learning rate ($log\ \Phi$) = -1.85188 × log 2 = -0.5575
The learning rate (Φ) = the antilog of (-0.5575) = 0.27703
The progress ratio (P) = (1 – 0.27703) = 0.7229

Table 1: Learning Curves for Average Cost

Log of Explanatory Variable and Test Statistic	Regression Coefficients of Equation 1	
	Without AR(1)	With AR(1)
Cumulative Production (CQ) Volume	-0.3715 (-3.7422)*	-1.8518 (-5.7172)*
Constant term for the regression	7.6595 (5.2889)*	32.5478 (5.6077)*
R-square	0. 2414	0. 924167
Adjusted R-square	0.2242	0.9206
F- statistic	14.0041*	255.9251*
Durban-Watson statistic	0.1599	1.997861

Note: Values in parenthesis are t-values while Asterisk (*) shows level of significance at 1 percent.

This progress ratio of 72.3 percent means that each doubling of cumulative output (in the manufacturing sector of Pakistan) leads to a

27.7 percent reduction in unit cost. In other words, the new average cost for doubling the quantity will be 72.3 percent of the previous average cost. These findings are more or less consistent with the literature as presented by Yelle (1979) and the findings of Thomas and Dutton (1984). Moreover, the AR(1) procedure also indicates that the previous year's average cost levels in the manufacturing sector do affect the current year's learning rate in terms of lower average cost.

2.2 Estimation of Augmented Cost Learning Curve

The cost learning curve is focused on the manufacturing experience gains in terms of lower unit cost of production in Pakistan, due to increased learning-by-doing (experience). This results in increased cumulative output and scale economies, resulting from these cost drivers. Consequently, the study augments the cost equation, in order to check whether the cost reductions are due to production volume and/or related cost drivers. Regression analysis that comprises costs and outputs of firms of varying sizes and experience is used to identify scale and the learning economies. Hence, the study uses the following double log functional form (equation 2) used by Bensanko *et al.* (2004):

$$\ln AC_t = \alpha + \in \ln CQ_t + \beta_1 \ln WR_t + \beta_2 \ln EC_t + \beta_3 \ln RM_t + \beta_4 \ln CS_t + \beta_5 \ln VI_t + \varepsilon_t \ldots..(2)$$

Where
AC = Average Cost
CQ = Commulative Output
WR = Wage Rate
EC = Energy Cost
RM = Raw Material
CS = Capital Stock
VI = Vertical Integration
α = intercept term
ε = error term

The results of equation 2 [without AR(1)] is given in Table 2, which indicate the existence of learning economies, i.e. the average cost declines with cumulative experience captured by cumulative output. This can be

seen by the coefficient of cumulative output which is significant at 1 percent significance level. The value of the parameter ϵ (-0.5086) represents the elasticity of average cost with respect to cumulative output, suggesting that if cumulative output goes up by 1 percent on average, the average cost goes down by about 0.5086 percent.

Moreover, the negative sign indicates a downward movement along the learning curve; i.e. firms enjoy lower average cost in second year of production. The average cost falls with cumulative experience across several years. Thus, the experience acquired in the preceding years will enable the firm to revamp its production techniques. The initial model, however, has the problem of autocorrelation, as indicated by the value of Durban-Watson test (1.1148). In order to remove this problem of serial correlation, the study uses the first order autoregressive iterative method [with AR(1)]. The result shows improvement in the learning index, which is about 0.2033 percent. Hence, the overall learning index with autocorrelation corrected regression is about 0.7119 percent. This learning index has the associated learning rate of 0.6105 and progress ratio of 0.3895. This progress ratio of 38.95 percent shows that doubling of cumulative output leads to a 61.05 percent reduction in unit cost which is unusually high, considering the literature (Yelle, 1979; Thomas and Dutton, 1984). This suggests that, in the presence of cost drivers, learning-by-doing phenomenon is very strong in Pakistan's manufacturing sector. This may be due to the extended learning which is associated with the input factors such as, raw material management, efficient capital utilization, gaining advantage from vertical integration etc. Moreover, the presence of autoregressive order one term indicates that the previous year's average cost levels affect the current year's learning rate in terms of lower average cost.

On the other hand, the variables for scale economies are wage rate, energy cost, raw material, capital stock and vertical integration i.e. the cost drivers. The parameters of these variables are all insignificant (but retained because of the strong theoretical relationship) except for vertical integration and wage rate, which are significant at 1 percent and 5 percent levels, respectively. The signs of these variables are also appealing; wage rate has a positive sign, showing that wages increase the average cost of

production and so does the raw material, capital stock and vertical integration.

However, surprisingly the energy cost coefficient has a negative sign, showing that for every one percent increase in the cost of energy the average cost declines by 0.4 percent. This might be due to the fact that the manufacturing sector has been using energy efficient techniques of production along with more sophisticated machinery. The t-value, however, shows that the value is insignificant, both with and without autocorrelation corrected regression. This further strengthens our hypothesis that economies of learning exist strongly in Pakistan.

The results mentioned in Table 2 give the impression that learning-by-doing phenomenon is very strong in Pakistan, superseding even the conventional notion of economies of scale. The manufacturing sector of Pakistan manages to reduce its average cost through joint efforts of managers and workers. Factors such as experience, motivation of workers, better organizational tactics, methods of manufacturing, etc., help firms to reap the benefits of lower average cost during the subsequent years of production.

Economies of scale have generally been associated with an increased output but lower average cost of production. However, this is not the case with our results, since the costs of inputs increases as output increases. Moreover, the economies of scale are subject to two main raison d'être, namely indivisible inputs and factor specialization – a worker who is specialized in one task. We can say that this is not the case in the manufacturing sector of Pakistan. However, factor specialization in terms of work continuity and repetition does exist i.e. the learning-by-doing phenomenon.

Table 2: Learning and Scale Economies for Average Cost

Log of Explanatory Variables and Test Statistic	Regression Coefficients	
	Without AR(1)	With AR(1)
Cumulative Output (CQ) Volume	-0.5086 (-3.74)*	-0.7119 (-3.91)*
Wage Rate (WR)	1.2929 (2.22)**	0.9394 (1.07)
Energy Cost (EC)	-0.3958 (-0.79)	-0.0222 (-0.04)
Raw Material (RM)	0.2622 (0.62)	0.3262 (0.59)
Capital Stock (CS)	0.0843 (0.49)	0.1467 (0.90)
Vertical Integration (VI)	0.6395 (9.45)*	0.5377 (6.52)*
Constant term for the regression	-6.6968 (-2.56)**	-5.5824 (-1.37)
R-square	0.9439	0.9582
Adjusted R-square	0.9353	0.9503
F- statistic	109.49	121.16
Durban-Watson statistic	1.1148	1.7243

Note: Values in parenthesis are t-values while Asterisk (*), (**) show level of significance at 1 percent and 5 percent, respectively.

3. Conclusions

This study used the manufacturing experiences of learning, in terms of lower unit cost of production, to assess the learning-by-doing hypothesis of Pakistan's manufacturing sector at the aggregate level. It is found that 27.7 percent learning rate exist in the manufacturing sector of Pakistan i.e. for every 1 percent increase in cumulative output (experience), the average cost decreases by 27.7 percent. Moreover, the study simultaneously explored the presence of economies of scale with cost drivers and learning economies with cumulative production. The results show that learning rate rose significantly from 27.7 percent to 61.05 percent, which is somewhat contradictory to the existing literature. On the other hand, the results of cost drivers are not significant, which suggests that in the presence of cost drivers the learning-by-doing phenomenon is very strong in Pakistan's manufacturing sector. Hence, to compete with the developed countries and to retain our competitive advantage, we need to improve on-the-job skill of labourers which will ensure that Pakistan's manufacturing sector becomes cost-effective.

References

Abernathy, W. J. and N. Baloff 1973. "A Methodology for Planning New Product Start-Ups" *Decision Sciences* 4(1): 1-20.

Adler, P. S., and B.C. Kim 1991. "Behind the Learning Curve: A Sketch of the Learning Process" *Management Science* 37(3): 267–281.

Ahmad, E. and M. Idress 1999. "The Time Profile of the Cost Structure in Pakistan's Manufacturing Sector" *The Pakistan Development Review* 38(4): 1101-1116.

Alchain, A. 1963. "Reliability of Progress Curves in Air-frame Production" *Econometrica* 31(4): 679-693.

Argote, L. and D. Epple 1990. "Learning Curves in Manufacturing" *Science* 247(4945): 920-924.

Asher, H. 1956. *Cost-Quantity Relationships in the Airframe Industry*. Santa Monica: RAND Corporation, Report 291.

Becker, S. and N. Baloff 1969. "Organization Structure and Complex Problem Solving" *Administrative Science Quarterly* 14(2): 260-271.

Bensanko, D., D. Dranove, M. Shanery and S. Schaefer 2004. *Economics of Strategy*. Third Edition, John Wiley and Sons, Inc.: New York.

Burki, A. A., M. A. Khan, and B. Bratsberg 1997. "Parametric Tests of Allocative Efficiency in the Manufacturing Sectors of India and Pakistan" *Applied Economics* 29(1): 155-169.

Carr, G. W. 1946. "Peacetime Cost Estimation Requires New Learning Curves" *Aviation* 45(4): 76-77.

Chishti, S. and F. Mahmud 1988. "Energy Substitution in Pakistan's Manufacturing Sector" *Pakistan Economic and Social Review* 26(1): 17-64.

Chishti, S. and F. Mahmud 1991. "The Energy Demand in the Industrial Sector of Pakistan" *The Pakistan Development Review* 30(1): 83-88.

Conway, R. and A. Schultz 1959. "The Manufacturing Progress Function" *Journal of Industrial Engineering* 10(1): 39-53.

Crawford, J. R. and E. Strauss 1947. *World War II Acceleration of Airframe Production*. Air Material Command, Dayton, Ohio.

Hirsch, W. Z. 1952. "Manufacturing Progress Functions" *Review of Economics and Statistics* 34(2): 143-155.

Khan, M. H. and A. A. Burki 2000. "Estimation Allocative Efficiency and Elasticities of Substitution in the Large-scale Manufacturing Sector of Pakistan" *Pakistan Journal of Applied Economics* 16(1&2): 49-63.

Mahmood, Z. 1989. "Derived Demand for Factors in the Large-scale Manufacturing Sector of Pakistan" *The Pakistan Development Review* 28(4): 731-742.

Mahmood, Z. 1992. "Factor Price Shocks, Factor Substitution and their Implications for Policy" *International Economic Journal* 6(4): 63-73.

Middleton, K. 1945. "Wartime Productivity Changes in the Airframe Industry" *Monthly Labor Review* 61(8): 215-225.

Muth, F. J. 1986. "Search Theory and the Manufacturing Progress Function" *Management Science* 32(8): 948-962.

Roberts, C. P. 1983. "A Theory of the Learning Process" *Journal of Operational Research Society* 34(1): 71-79.

Scherer, F. M. 2001. "An Early Application of the Average Total Cost Concept" *Journal of Economic Literature* 39(3): 897-901.

Searle, A. D. and C.S. Goody 1945. "Productivity Increases in Selected Wartime Shipbuilding Programs" *Monthly Labor Review* 61(6): 1132-1147.

Sheshinski, E. 1967. "Tests of the Learning by Doing Hypothesis" *Review of Economics and Statistics* 49(4): 568-578.

Thomas, A. and M.J. Dutton 1984. "Treating Progress Function as a Managerial Opportunity" *Academy of Management Review* 9(2): 235-247.

Wizarat, S. 2003. *The Rise and Fall of Industrial Productivity in Pakistan*. Lahore: Oxford University Press.

Wright, T. 1936. "Factors Affecting the Cost of Airplanes" *Journal of Aeronautical Science* 3(4): 122-128.

Yelle, L. E. 1979. "The Learning Curve: Historical Review and Comprehensive Survey" *Decision Sciences* 10(2): 302-328.

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Corruption and the Role of the National Accountability Bureau in Pakistan (1999-2009)

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Abstract: The study analyses the magnitude of corruption in Pakistan and explores the causes and consequences of these corrupt practices in Pakistan. It also scrutinises the performance of the National Accountability Bureau (NAB) by using quantitative as well as qualitative tools of assessment. The study reveals that the estimated amounts of corruption in Pakistan range between $12.5-19.5 billion annually. In this backdrop, the inability of NAB to cut down on these pilferages, along with various qualitative aspects of its performance and institutional hindrances are a serious setback to Pakistan's drive towards being a corruption-free society.

Keywords: Corruption, Accountability, NAB
JEL Classification: 11H, 73D

1. Introduction

The practice of corruption may well be as old as civilization itself. However, awareness and actualization of corruption dates back to 1939, when Professor Edwin Hardin Sutherland coined the term "white-collar crime".[1] Recently, Corruption has become one of the most widely debated and discussed issues in good governance. Corruption is equivocally recognized to be among the world's greatest challenges. It is considered by many as a major impediment to sustainable development, with a detrimental effect on poor communities (United Nations Global Compact, 2010). Consequently, specialized agencies have been created the world over, especially in the developing countries to control and combat corruption. These include:

- The United States Office of Government Ethics
- The Anticorruption Office (ACO), Argentina
- The Korea Independent Commission Against Corruption (KICAC), South Korea

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[1] Mauro (1995), Transparency International, (2010)

- The Hong Kong Independent Commission Against Corruption (ICAC)
- Corruption Practices Investigation Bureau (CPIB), Singapore
- Malaysian Anti-Corruption Commission, (Heilbrunn, 2004)
- National Accountability Bureau (NAB, 2010)

1.1 Impact of Corruption

Empirical studies, undertaken in the recent past, provide significant empirical evidence that corruption lowers investment and economic growth (Mauro, 1995). The argument is more pronounced with reference to the developing countries where high corruption may as well reduce the effectiveness of aid flows (IMF, 1995). The World Bank identified corruption as an obstacle to economic and social development, as it undermines development by distorting rule-of-law and weakening institutional foundation on which economic growth depends (Rose-Ackerman, 1997). However, this notion of the impact of corruption being regressive in nature has been challenged by some. It is so, because some countries alleged to be very corrupt have experienced high levels of economic growth. In Indonesia, Thailand and Korea, corruption and growth have gone together (Rose-Ackerman, 1997). In certain cases, corruption has been shown to have had a positive effect on the economic growth as well (Kuncoro, 2006).

The same, however, cannot be said about corruption and poverty alleviation. Corruption has been seen to have a significant negative impact on poverty (Chetwynd *et al.,* 2003). Results from the TI Global Survey 2007 show that poor citizens are bound to pay more bribes than other income groups. Those who cannot afford to bribe are further marginalized, left without access and turned into forgotten citizens (Transparency International, 2008).

Similarly, corruption has been seen to have a direct impact on the debt ratios i.e. higher corruption leads to higher debt ratio. Corruption has also been found to inflate spending in the public sector, but the effect of this public investment on economic growth is lower where corruption is high (Haque and Kneller, 2008). Similar findings have been presented with

respect to government revenues, infrastructure and investment (Tanzi and Davoodi, 1997). The immediate effects of corruption also include further impoverishment of the people as well as the weakening of democratic institutions. Many a dictatorial regimes have ousted democratically elected governments on grounds of corruption. In fact, many of the dictatorial regimes were installed as a result of palace coups or military rebellions citing the corruption of democratic regimes as a major cause (Pope, 2002).

Other consequences of corruption may include:

- Reducing the incentive to invest.
- Lack of effectiveness of aid flows.
- Loss of tax revenue
- Inferior public infrastructure
- Adversely affecting the composition of government expenditure (Mauro, 1996).

2. Literature Review

The focus of the review was on three aspects of the study. First, the relation of corruption with respect to various growth variables was studied so as to provide a foundation for the framework. Second, previous studies undertaken with respect to NAB and other anti-corruption agencies were reviewed. Finally, literature was sought on the validity of methods of corruption measurement and the accuracy of the corruption indices as a means of providing a correct estimate.

Lui (1985) used the queing model, he suggested that bribery/corruption can act as *grease money*. According to the study, corruption could be growth-enhancing. Kuncoro (2006) also analysed various aspects of corruption as a rent-seeking behaviour and analysed how, given a certain criteria is fulfilled, corruption can lead to an increase in investment and, consequently, economic growth. Similar results were deduced by Colombatto (2003), who analysed corruption in different institutional scenarios and found that corruption may lead to positive impact on growth, especially in the case of developing countries and totalitarian regimes. Javaid (2010) gave an overview of the genesis of corruption in Pakistan. The study supports Colombatto's hypothesis that corruption,

paradoxically, acts as the balancing mechanism in an unregulated administrative paradigm. Rose-Ackerman (1997), however, suggests that although in certain instances (Indonesia, Thailand as well as Korea) higher corruption has led to a higher growth rate, it would only be a short term effect, as the percentage of corruption would continue to increase till such time that it starts to impede a country's economic growth.

The general agreement, however, is that corruption would have an adverse impact on the growth and investment. Mauro (1996) analysed a cross-country data set consisting of corruption indices and various categories included in political stability and found that corruption lowers investment, consequently lowering economic growth. Tanzi and Davoodi (1997) found that while corruption leads to an increase in public investment, it reduces its productivity. Evidence also suggests that corruption decreases government revenues and adversely affects the quality of infrastructure, impeding economic growth. Similar results are found by Tanzi (1998), Haque and Kneller (2008) and Chetwynd *et al.*(2003), the latter highlighting the relationship between corruption and increase in poverty.

The performance of the Anti-corruption agencies has been reviewed by Doig *et al.* (2006) who reviewed several reports and articles on the role and the purpose of various Anti-Corruption Agencies or Commissions (ACC). Specific to Pakistan, Khan *et al.* (2004) and Samad (2008) analysed the performance of National Accountability Bureau (NAB). It was concluded that NAB has been unable to achieve the goal for which it came into existence. Furthermore, there is noticeable shift in the working of the bureau from being a prosecutorial agency to an institution for the recovery of assets as well as a political tool for arm-twisting.

A number of indices are being used to guage corruption as well as accountability in various countries. In a cross-country analysis Kaufmann *et al.* (1999) studied the relation between governance and per capita income in 173 countries. Using over 300 governance indicators for the years 1997-98, the team created comprehensive indicators for Voice and Accountability, Control of Corruption, Political Stability etc. It shows a positive relationship running from improvement in governance to enhanced development outcomes measured through the per capita income. While these remain largely unchallenged, Weber (2007) challenged the

validity and accuracy of the perception based indices (such as Corruption Perception Index) that are used to measure corruption. Regression analysis shows that perceptions about corruption consistently correlate among themselves. Opinions about the general effects of corruption are correlated strongly with other opinions such as human rights, violence etc. Olken (2009), while concluding that reported perceptions are valid to a large extent, found that there are biases in the reported perceptions. The paper demonstrates the limitations of relying only on the perceptions of corruption, whether in designing anti-corruption policies or in empirical research.

The literature provides evidence that in the majority of the cases, corruption would lead to a lower economic growth. However, evidence also exists that in developing countries such as Indonesia, Bangladesh etc. corruption may act as 'facilitating money'. NAB has come under severe criticism for succumbing to political pressure and many a causes have been identified in this regard. The validity of perception based indices has also come under scrutiny. The limitations of corruption indices based solely on perception are evident. However, in certain cases, it provides the best-possible means of evaluation.

3. Methodology and Data

The study is a descriptive analysis of the performance of the National Accountability Bureau and the relationship between corruption and GDP with respect to Pakistan. It makes use of the quantitative data to provide a basis for the cost-benefit analysis of the role that NAB has played. Moreover, it makes use of several case studies to show the qualitative side of the organisation. In order to assess the relationship between growth and corruption, the study makes use of simple time series analysis through charts and graphs.

The data has been collected from various sources. The data on the performance of NAB has been obtained primarily from the office of the bureau itself, alongwith information that has been collected from various newspapers and journals. It includes the amount of the recoveries that have been made by NAB to date as well as the details of prosecution.

The estimates of the amount of corruption in Pakistan have been obtained from reports by the World Bank, the Auditor General of Pakistan and the Centre for Trade and Governance. They provide absolute as well as percentage estimates of the amount of corruption taking place within the country. The measures of Accountability have been obtained from the Transparency International, The World Bank Governance Indicators and the International Country Risk Guide (ICRG) which provide measure of accountability, corruption and political stability in the country.

4. Corruption in Pakistan

Corruption is, by no means, a new phenomenon in Pakistan. After the World War II, the world experienced a substantial increase in procurement-related corruption. Concerns were raised for the same in the sub-continent as well, which led to the drafting of anti-corruption laws by the British. Ever since independence, rampant corruption in the country has led to much hue and cry. Dr. Mehboob-ul-Haq claimed that almost 10-15 percent of the development budget went in the pocket of those who exercised control over issuance of the budget. Similarly, the provision of Statutory Regulatory Order (SRO) has been regularly abused by those in power (Rehman, 2000).

Not much has changed since the establishment of NAB. Despite the existence of strong accountability legislation, Pakistan's 2009 Corruption Perceptions Index Score is 2.4, and out of 180 countries, its ranking as most corrupt country has slipped 5 ranks, from 47th in 2008 to 42nd most corrupt country in 2009 (Transparency International, 2009). The Worldwide Governance Indicators (WGI) provided by the World Bank have also revealed weak scores in most areas. There has been a rapid decline in indicators for political stability, which have deteriorated rapidly since 1998; 1.0 in 2007 as compared to 5.8 in 2003 or 11.11 in 1998 (Chêne, 2008). Moreover, in the Global Competitiveness Report for the year 2010–2011, Pakistan has been ranked 123rd out of 139 countries and found that corruption was the second most problematic factor for the respondents in doing business in the country (World Economic Forum, 2010). The World Bank, as well as the Auditor General of Pakistan, has frequently cited problems of governance in recruitment, site selection and corruption in various developmental projects. Some of the World Bank's

projects were even partly suspended or cancelled e.g. the Balochistan Primary Education Project (World Bank, 2006).

4.1 Causes of Corruption in Pakistan

Pakistan is a classic case of a colonial legacy, which has led to the creation and strengthening of the feudal and industrial elites who, in turn, have hindered the process of education and empowerment among the masses. The Corruption Survey Report of 2002 provides the following causes of corruption:

- Lack of accountability is seen by the majority as the primary cause of corruption.
- Another important cause identified is the lack of transparency / adequate information
- Low salaries are cited by many as the fundamental cause of corruption in Pakistan.
- Other causes identified in the survey include too much discretionary power, power of the influential people and red-tapism (Transparency International, 2002).

The role of politicians, majority of whom belong to the feudal-industrial complex, in promoting and strengthening corruption must not be overlooked as well. A majority of the members of parliament either belong to this group, or become a part of it once they are elected as the representatives of the people.

Bureaucratic corruption, however, is still regarded by many as one of the major challenges faced by Pakistan and is fuelled by the following factors:

- Poor pay structure.
- The importance of culture, i.e. family ties and resultant nepotism.
- The ready availability of speed money.
- An overall lack of respect for the rule of law (Khattak *et al.*, 1999).

4.2 History of Accountability in Pakistan

Even in the pre-partition subcontinent, anti-corruption laws were drafted. The first ever anti-corruption agency, created for this purpose, was the

Special Police Establishment. One such law, that Pakistan adopted in its interim constitution at the time of partition was the Prevention of Corruption Act (PCA) at Independence in 1947. Moreover, during the latter years, laws like the Public Representatives (Disqualification) Act 1949 and the Elected Bodies (Disqualification) Ordinance 1959 were promulgated. The anti-corruption legislations that have been promulgated since independence are presented in Table 1.

Table 1: Anti-Corruption Legislations in Pakistan (1947-2009)

Year enacted	Title	Present Status
1947	Prevention of Corruption Act	In force
1949	Public Representatives Disqualification Act	Repealed
1958	Elected Bodies Disqualification Ordinance	Repealed
1997	Ehtesab Act	Repealed
2000	National Accountability Bureau Ordinance	In Force
2007	Anti-Money Laundering Ordinance	In Force

Source: NACS, 2002, updated by the author.

Similarly, Anti-corruption agencies have also been in place ever since independence. The West Pakistan Anti-Corruption Establishment 1961 created the provincial Anti-Corruption Establishments (ACEs). The Pakistan Special police Establishment (PSPE) was replaced by Federal Investigation Agency (FIA) in 1975. The Ehtesab Bureau was instituted in 1997 augmenting the Ehtesab Commission of 1996. Table 2 presents a list of such agencies.

Table 2: Anti-Corruption Agencies in Pakistan (1947-2000)[2]

Name	Year Established	Jurisdiction	Functions
Anti-Corruption Establishment	1961	Provincial	Check on corruption in provincial government
Federal Investigation Agency (FIA)	1975	Federal	Immigration, financial and cyber-crime; anti-terrorism
Ehtesab Bureau	1997	Federal	Public and private sector; white-collar crime
National Accountability Bureau (NAB)	2000	Federal	Public and private sector; white-collar crime

Source: NACS, 2002.

In addition to these specialised organisations, other governmental structures which have been responsible for accountability within the country include:

- Public Accounts Committee (PAC)
- Parliament's Standing Committees
- Departmental Accountability Committees
- Prime Minister's Inspection Commission

The performance of the institutions before NAB was appalling to say the least. The bureaucratic institutions were all deep rooted in corruption. Moreover, the higher judiciary had generally sided with the establishment over the course of history. Similarly, the International Crisis Group observed that the lower judiciary is heavily involved in large-scale corruption (International Crisis Group, 2003). In view of such circumstances, the creation of a specialised anti-corruption agency seemed inevitable.

[2] No specialized anti-corruption agency has been created since the establishment of NAB.

4.3 The Promulgation of NAB Ordinance 1999

It may be appropriate to consider the Ehtesab Act of 1997 as the first serious attempt to combat corruption at the federal level. The legislation served as the basis for the NAB Ordinance of 1999. Indeed many parts of the latter legislation have been directly borrowed from the earlier. The Ehtesab Act and the Ehtesab Bureau, however, lost their appeal among the masses as well as the international agencies as it was considered by many as a political tool for victimisation.

The National Accountability Ordinance was promulgated by Gen. Pervez Musharraf, a year after the coup, in 1999. The legislation was hailed by the pro-government quarters as a "ground-breaking" step towards combatting corruption. The ordinance provided for the creation of National Accountability Bureau. Not everyone, however, was all praise for this act of a "dictatorial" regime. Many considered it to be an attempt similar to the one by Mian Nawaz Sharif, so as to create a tool for political arm-twisting and victimisation. As observed by the Human Rights Watch in its annual report for Pakistan in 2000, "... The Ordinance confers sweeping powers of arrest, investigation, and prosecution in a single institution, the National Accountability Bureau (NAB). It permits detainees to be held for up to ninety days without charge, and at trial places the burden of proof on the defendant. Persons convicted under the ordinance are automatically prohibited from holding public office for a period of twenty-one years - a provision that is being used to remove leaders of major political parties from power." (Human Rights Watch, 2000).

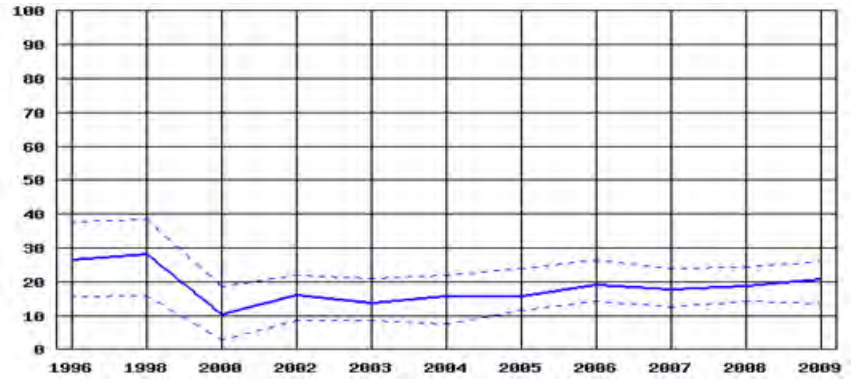
5. Analyses

The quantitative analysis in the study is divided into three parts: the accountability in Pakistan, the estimates of the financial losses due to corruption and the performance of NAB in terms of recovery and prosecution.

5.1 Indicators for Accountability

In order to analyse the performance of Pakistan in terms of accountability and control of corruption, various indices issued by international agencies were used. These provide a perception-based as well as quantitative breakdown of the levels of prevalent corruption and the effectiveness of accountability mechanisms.

Figure 1: Voice and Accountability in Pakistan (2009)

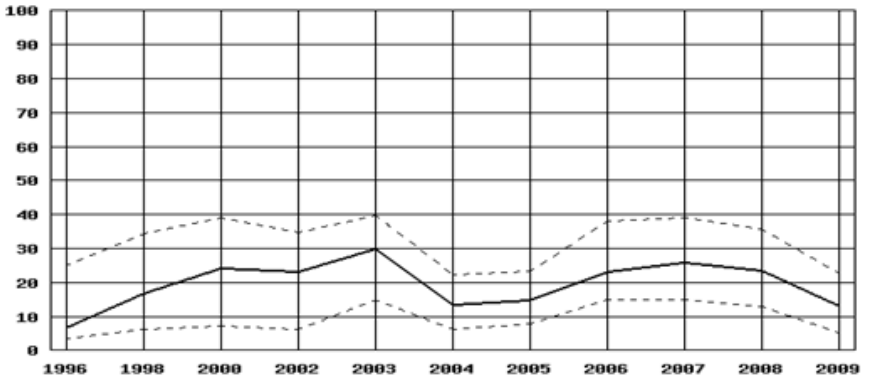


Source: World Bank, 2010.

Figure 1 shows that since 1998, voice and accountability in Pakistan has fallen heavily. There has been only a slight improvement in the last ten years but overall, Pakistan has performed poorly in terms of the improvement in terms of accountability. Pakistan has been consistently marked in the 20th percentile, showing extremely poor standards of voice and accountability in the country.

Similarly, the control of corruption in Pakistan, as estimated by WGI is shown in Figure 2. It suggests that performance of Pakistan, in terms of control of corruption, was preeminent during 2000-2003. This is the time during which Pervez Musharraf strengthened NAB and backed his claim of eradicating corruption. However, the advent of political regimes and political arm-twisting worsened the situation yet again. The country has been on a downward hill ever since.

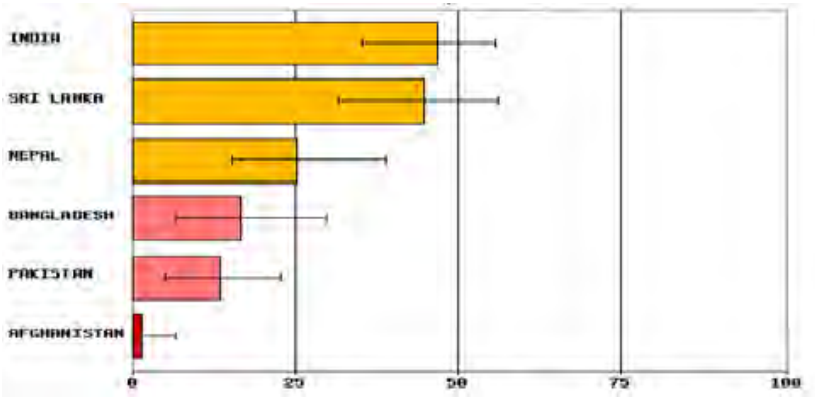
Figure 2: Control of Corruption in Pakistan (2009)



Source: World Bank, 2010.

Finally, a comparative analysis of the control of corruption in South-Asia is given in Figure 3.

Figure 3: Control of Corruption: Countries' Percentile Rank (2009)



Source: World Bank, 2010.

Figure 3 shows that in the region, Pakistan is better than Afghanistan only, which is an achievement by no means at all.

The ratings by the Political Risk Services Group, known as the International Country Risk Guide (ICRG), rate countries on a scale of 0-6,

where 0 represent very high risk and 6 represents extremely low risk. ICRG is the oldest and most widely used risk rating. It has been regularly used as an authentic means of measurement of corruption in a country. Table 3 shows that Pakistan has been consistently marked in the lower half and in view of these ratings, poses a high degree of risk in terms of corruption. Pakistan's best score has been 3. On the other hand, India, Srilanka and Malaysia have an average score of 3 while the likes of Hong Kong and Singapore have consistently scored 4 or more.

Table 3: ICRG Ratings for Pakistan (1999-2009)

Year	Score (1-6)
1999	3
2000	2
2001	2
2002	1.5
2003	1.5
2004	1.5
2005	1.5
2006	1.5
2007	2
2008	2
2009	2

Source: Political Risk Services, 2010.

Another measure of corruption is given through ratings issued by the Transparency International by the name of Corruption Perception Index (CPI) which measures the perceived levels of corruption by combining various independent sources. The CPI rates a country between 0-10; zero being most corrupt and ten being least corrupt. The year wise ratings and rankings for Pakistan are presented in Table 4. A similar index used to analyse corruption in a country has been developed by the World Bank, and is known as the Control of Corruption Index (CCI). It rates countries between -2.5 to +2.5, where a positive score means better governance and

vice versa. The scores for both these indices suggest that Pakistan has been unable to effectively control corruption in the country.

Table 4: Corruption Perception Index for Pakistan (2000-2009)

Year	Rank	CPI Score
2000	--	--
2001	79/91	2.3
2002	77/102	2.6
2003	92/133	2.5
2004	129/145	2.1
2005	144/159	2.1
2006	142/163	2.1
2007	138/179	2.4
2008	134/180	2.5
2009	139/180	2.4

Source: Transparency International, 2009.

Table 5: Control of Corruption Index for Pakistan (1999-2009)

Year	Score (-2.5to+2.5)
2000	-0.81
2001	--
2002	-0.87
2003	-0.73
2004	-1.11
2005	-1.07
2006	-0.76
2007	-0.72
2008	-0.78
2009	-1.1

Source: World Bank, 2010.

5.2 Estimates of Financial Losses Due to Corruption

The direct financial losses though corruption are difficult to measure, but significant. According to NACS Report, estimated revenue lost by corruption is 64 percent, 48 percent, and 45 percent in income tax, customs and sales tax, respectively. If this perception is considered to be correct, then the amount of revenue loss can go over Rs. 200 billion per annum (Rahman, 2003).

An estimate of the financial losses can be obtained from the reports made public by the Auditor General of Pakistan. Auditor General's Report for the fiscal year 2009-10 made public that Rs. 801.06 million were lost due to violation of rules, Rs. 809.54 million rupees due to unauthorised expenditures and Rs. 379.84 million rupees due to non-recovery of dues. (The Daily Dawn, 2010). Other estimates of corruption in Pakistan reveal that the situation is much worse. According to some studies, the national exchequer experiences annual losses of Rs. 1,627 billion ($19.14 billion) (Raza, 2008a; 2008b). The figures are currently being revised by the Center for Trade and Governance and it is believed that the revised estimates would be close to $22.5 billion.

It is evident that the amount lost due to tax-evasion, embezzelment in the annual development program etc. accrue in a significant social cost, resulting in low quality infrastructure and loss of public welfare. However, tax-evasion, and evasion of imports and duties make investment in the country a lucrative option. Moreover, if the World Bank estimate is to be considered correct then, the amount lost due to corruption from 2000-2008 is estimated to be $94.58 billion. This is nearly twice as much as our foreign debt ($ 50.1 billion). Table 6 presents a sector-wise estimate of annual revenue loss to the exchequer due to corruption.

Table 6: Estimated Annual Pilferage/Revenue Loss to Exchequer

Sr. No.	Sector	Rupees (Billion)
i.	Evasion of federal taxes and duties	
	Customs duty	150
	Sales tax at imports and local production	300
	Central excise duty	50
	Income tax	150
ii.	Counterfeiting of special adhesive and non-judicial stamp papers	25
iii.	Counterfeiting of postal stamps and envelopes	2
iv.	Theft of National Savings Certificates	5
v.	Counterfeit currency notes	20
vi.	Payment of export rebates against bogus claims	50
vii.	Evasion of provincial taxes	75
viii.	Import of substandard diesel	50
ix.	Writing off of bank loans	20
x.	Arbitrary pricing of POL products	30
xi.	Bribes and kick-backs by federal and provincial government officers	600
xii.	Pilferage of funds from Annual Development Programme	100
Total		1,627

Source: CenTraG, 2009.

5.3 Prosecution and Recovery

NAB's performance in terms of recovery has been hailed by its advocates. The statistics have been used by the NAB officials as well as the governments in power to prove their commitment to the cause of the eradication of corruption.

According to the data made available, the recoveries made by NAB till date are as follows:

Table 7: Accumulated Recoveries by NAB (till 2009)

Sr. No.	Contents	Accumulated Recoveries
		Rs in Billion
i.	Bank Default	116.858
ii.	Voluntary Return and Plea Bargain	24.60
iii.	Rescheduling of loan	60.47
iv.	Indirect Recoveries	9.21
	Grand Total	210.89

Source: NAB, 2010.

NAB has been able to recover large sums and returned them to those affected by these scams. The contentious issue, however, is the amount recovered through plea-bargaining. Allegations have been levied against NAB officials for accepting bribes and kickbacks. However, NAB refuses to disclose the total amount involved in these cases. Similarly, NAB's record in terms of prosecution is given in Table 8. The statistics suggest that in almost 65 percent of the cases decided, NAB has been unable to obtain a conviction. The reasons are multi-faceted, including political pressure, lack of evidence etc., but it signifies a major failure of the bureau to provide swift and across-the-board accountability.

Table 8: Prosecutions by NAB (till 2009)

Prosecution	Till 2009
1. Cases Filed in Court	1643
2. Cases Decided	916
a. Convicted	556
b. Acquitted	232
c. Withdrawn/Terminated	128
3. Cases in Progress	727

Source: NAB, 2010.

Another important aspect of the recovery process is the cost of recovery. The simple economic cost of recovery can be calculated by comparing the amount recovered with the annual budget allocated for NAB in the national exchequer. This, however, does not include the share that NAB received from the recoveries that it had made, something that has understandably not been disclosed by the NAB authorities. The figures are presented in Table 9 as follows:

Table 9: Budgetary Allocations for NAB (till 2009)

Fiscal Year	Budget in Millions (Rs)
2000-01	349.309
2001-02	340.529
2002-03	358.995
2003-04	409.290
2004-05	467.058
2005-06	752.424
2006-07	792.000
2007-08	897.000
Grand Total (in billions Rs)	4.367

Source: NAB, 2010

Total budgetary allocations, compared with the amount recovered (Rs. 210.89 billion), gives a ratio of 1:48 i.e. for every rupee that has been spent on NAB, it has recovered 48 rupees for the national exchequer.

5.4 NAB: A Success Story or Otherwise?

NAB's performance can be judged indirectly by looking at the Corruption Perception Index (CPI), presented in the earlier section. It is evident that there has been a clear failure on the part of anti-corruption agencies to prevent corruption. In fact, the situation in Pakistan has deteriorated with the passage of time. Pakistan has slipped lower and lower in the rankings and is currently the 42nd most corrupt country in the world. Clearly, NAB

has not played an effective enough role in the prevention of corrupt practices in the country.

Till date, NAB has recovered Rs. 145.011 billion or approximately $ 1.7 billion. This is a considerable sum in its absolute value. However, if the estimated figures of the amount of corruption are to be correct (as discussed in the previous section), then it is merely a fraction of the total amount lost due to corruption, since 2000 (approximately $94.5 billion). Moreover, as observed in earlier studies, not a single high-profile politician has been successfully prosecuted by NAB despite there being a strong consensus about their involvement in corrupt practices. This holds true to date.

5.5.1 Criticism on the NAB Ordinance

As stated earlier, many of NAB's provisions were thought to be seriously violating a serious violation of the human rights. The major provisions which received scathing criticism from the social quarters as well as human rights observers are:

1. *Arrest without Warrant:* The ordinance allowed NAB to make arrests without any requirements of an arrest warrant. This was considered by many as a fundamental violation of the legal rights of an individual and consequently led to much hue and cry (Sethi, 2005). It was subsequently struck down by the Supreme Court in the later years.

2. *Plea Bargaining:* Perhaps the most controversial and widely criticized provision of the ordinance, allowed the Chairman NAB to strike a deal with the accused and grant pardon in return for some agreed amount. It has two fundamental issues attached with it. Firstly, in principle, it suggests that you can buy yourself out of a crime, which is itself a fundamental violation of all principles of justice. Secondly, in practice, it allowed for people to pay a fraction of the looted amount to be set free again. This has a two-pronged effect on the spread of corruption. It allows for people to indulge in corruption and then pay a fraction of it to the government and be free again. Moreover, it also allows for

corruption to set in within the anti-corruption agency, resulting in a loss of efficiency as well as credibility.

3. *Judiciary and Armed Forces Exempted:* The exemption given to judiciary and armed forces has been a major source of criticism, as it is a negation of the principle of across the board accountability. Moreover, research has shown these two branches of the government to be heavily involved in corruption. The International Crisis Group (2003) has declared the lower judiciary to be heavily involved in corruption. According to the survey conducted by Transparency International Pakistan (2008), 96 percent of the respondents who had to interact with the judiciary found it to be corrupt while 44 percent of them had to bribe court officials (Chêne, 2008). Similarly, in 2000, kickbacks in the arms deal allegedly amounted to $2.7 billion (Samad, 2008). Till date, this demand of bringing these two institutions under the jurisdiction of NAB has fallen on deaf ears.

Despite this criticism, there is a general consensus that the NAB Ordinance is one of the most comprehensive documents of anti-corruption legislation. It has been cited as a model by many countries, including Spain, Belgium etc. (Aziz, 2009).

5.5.2 A Tool for Arm-twisting

It has been repeatedly alleged that NAB has been used by the government for political arm-twisting. Most people elected in the elections of 2002, including the likes of Faisal Saleh Hayat and Aftab Sherpao, were linked with corruption in the past (Gauhar, 2005). NAB had entered into an agreement with Broadsheet, a specialist in asset recovery, for regaining the plundered national wealth stashed in foreign banks by public office holders. However, the company continually voiced its frustration over NAB's selective approach and what it termed as "political expediency" (Ali, 2003). Similarly, Kanwar Dilshad Ahmed, former Secretary of the Election Commission of Pakistan, alleged that in the recent elections of 2008, "NAB pressurised the Election Commission to register cases against PPP, which was contrary to the view held by the commission."

5.5.3 Succumbing to Political Pressure

The biggest criticism on NAB has been the fact that it has been repeatedly accused of giving in to the political pressure and succumbing to the wishes and whims of the politicians. It should come as no surprise that till date every Chairman, namely Lt. General (Retd). Amjad Hussain, Lt. General Shahid Aziz and Naveed Ahsan, has had to resign from the office due to unwanted intervention and pressure.

According to Lt. General (Retd) Shahid Aziz Khan, political/high profile cases are deliberately delayed by the ruling parties, to act as means for pressurising as well as political give-and-takes. In certain instances, NAB has been forced to withdraw cases against politicians due to pressure by the government, even when there is a proven case of corruption (Aziz, 2009).

5.5.4 Putting the House in Order

Another blow to NAB's credibility has been the fact that it has been repeatedly accused of striking under-the-table deals and its officials being involved in corruption themselves. Petitions have been filed in the High Court as well as the Supreme Court of Pakistan, which have accused NAB of taking massive kick-backs and that the provision of plea bargaining be struck down by the courts (Khan *et al.*, 2004).

5.6 A Misuguided Aproach?

The fundamental reason for NAB's ineffectiveness in preventing corruption can partly be attributed to a misguided stress on prosecution, rather than eradication of corruption. Despite the announcement of a National Anti-Corruption Strategy (NACS) in 2002, no practical steps have been taken towards eradicating corruption. This can be achieved through a three pronged action-plan i.e.

i. Making examples out of individuals (prosecution)
ii. Hindering the use of "dirty" money (anti-money laundering)
iii. Improving the system by ensuring good governance, awareness, as well as voice and accountability.

5.6.1 Inability to Set a Strong Precedent

There is a famous Chinese maxim, *"Kill one, frighten Ten Thousand."* The details of the cases of plea bargaining and convicted cases suggests that NAB is exhausting its resources in trialling petty cases ranging between few thousands and a few hundred thousand rupees only. The organisation's inability to trial high-profile and mega corruption cases is, perhaps, the most common and basic criticism on NAB (Raza, 2005). When Moeen Qureshi published the list of loan defaulters in 1999, Mian Aftab of Fazal Sons, a mega-defaulter, fled to Europe. NAB has been unable to bring him back to Pakistan, while he is happily operating a chain of three hotels and a health club in UK (Rehman, 2000). There are countless cases of a similar nature.

Another important case worth mentioning is the UN-Food-for-Oil Scandal. According to Lt. Gen. Shahid Aziz, "box loads of evidence" were provided by the UN against Benazir Bhutto and Asif Zardari in the scandal. However, according to the former chairman, it was conveyed to him by Mr. Tariq Aziz, the aide to the President, that these cases be closed as per the executive order of President Pervez Musharraf (Aziz, 2009).

Similar instances have been reported in the highly publicised "Sugar scam" as well as the case of blatant corruption in the oil sector. Despite clear indications of deliberate corruption, the cases were closed down due to government pressure, as it involved sitting members of the parliament as well as government aides. In the oil scandal alone, Rs. 80 billion are allegedly lost to corruption every year. Similarly, another related case was of the import of sub-standard diesel where the inquiry revealed a misappropriation of Rs. 90 billion annually. However, both these cases were closed without any action being taken against the criminals, some of these being members of the ruling party (CenTraG, 2009).

5.6.2 Combatting Money-Laundering

The other step in eradication of corruption is making the use of money obtained through corruption as difficult as possible. According to academics, money laundering follows the rule of PLI i.e.

- Placement: putting the black money into bank accounts/ economic projects.
- Layering: covering/mixing the looted wealth with legal wealth.
- Integration: making the money legal and putting it back into the system.

Pakistan took no practical steps in this regard uptil 2007, when the Anti-Money Laundering Ordinance (AMLO) was promulgated by the federal government. However, the law fails to address issues of fiscal offence i.e. over and under-invoicing, which allow for the "dirty money" to be drafted back into the system (Raza, 2007).

5.6.3 Ensuring Good Governance

In terms of improving good governance and accountability, not much has improved. In fact, much has been done to ensure that no improvement would take place. Laws like the National Reconciliation Ordinance (NRO) have been passed by the rulers and attempts to make NAB a toothless organization by passing the new accountability law are under consideration. People alleged to be involved in corruption are the ones who are currently sitting in the legislature. NAB has held activities such as debating and essay writing competitions along with conferences on corruption, but due to the prevalent situation and the conduct of the "role-models", it has not contributed much to raising awareness among the masses or improving governance within the country. Overall, NAB has focused more on recoveries and has, of late, become more of a recovery agency rather than the one it was envisioned to be. The inability to prevent the spread of corruption has been one of the major failings of the institution along with the inability to set a strong precedent.

6. Conclusions and Policy Recommendations

In light of the above discussion, following inferences can be drawn from the study:

1. Estimated amounts of corruption range between $12.5 billion to $19.5 billion annually. If Pakistan is able to control corruption for even a period of five years, it can rid itself of its external debt. Similarly, if Pakistan is able to control the levels of pilferage that

it is currently experiencing, it would allow us to meet our financial deficit and reduce the levels of borrowing.

2. The success of institutions such as NAB depends upon:
   - Support and independence from government.
   - A national anti-corruption strategy.
   - Governance activities that reduce incentive and opportunities for corruption (Doig and Williams, 2006).

Sadly, none of these exists in Pakistan. NAB is anything but independent from government's influence and the support from the government quarters is, but non-existent. A National Anti-corruption Strategy was launched in 2002, however, it lacks in implementation and also in the support received from the government. Finally, as pointed out by the former chairman of NAB himself "No hope can be rested on the parliament, which is itself a party to the crime." (Aziz, 2009).

If Pakistan is to achieve sustainable growth, it must rid itself of the menace of corruption. NAB is currently suffering from an extreme loss of credibility. This down-hill slide has been further augmented by government actions, such as passing the National Reconciliation Ordinance and the proposed Anti-Corruption bill which are directed towards making NAB a toothless body. Repeated government interference and influence have made NAB a mere tool for political bargaining, used by corrupt governments to victimise their opponents. The model, which has met with success in Honk Kong, Malaysia etc. is destined to fail in Pakistan, if drastic measures are not taken to rid it of the evils that have taken root.

References

Ali, R. 2003, November 03. NAB accused of selective approach. *Daily Dawn* .

Aziz, L. G. 2009, December 01. Islamabad Tonight with Nadeem Malik. (N. Malik, Interviewer)

CenTraG, 2009. *Article on Oil Corruption*. Retrieved July 14, 2010, from Center for Trade and Governance: http://centrag.org/eco_polsect_a.htm

Chêne, M. 2008. *Overview of Corruption in Pakistan.* U4 Anti-Corruption Resource Center.

Chetwynd E., F. Chetwynd and B. Spector 2003. *Corruption and Poverty: A review of Recent Literature.* Washington: Management Systems International.

Colomabatto, E. 2003. "Why is Corruption Tolerated?" *Review of Austrian Economics* 164(1): 363-379

Doig A., D. Watt and R. Williams 2006. "Hands-on or Hands-off: Anti Corruption Agencies in Action" *Public Administration and Development* 26(2): 163-172.

Gauhar, H. 2005. "Nabbed" *The Blue Chip* 2(1): 24-38.

Haque, M. E., and R. Kneller 2008. "Public Investment and Growth: The Role of Corruption" Centre for Growth and Business Cycle Research Discussion Paper Series 98, Economic Studies, University of Manchester .

Heilbrunn, J. R. 2004. *Anti-Corruption Commissions: Panacea or Real Medicine to Fight Corruption?* The World Bank Institute: Washington D.C.

Human Rights Watch, 2000. *Country Report: Pakistan.* Human Rights Watch: Islamabad.

IMF, 1995. *Unproductive Public Expenditures: A Pragmatic Approach to Policy Analysis*. IMF Pamphlet Series, Fiscal Affairs Department .

International Crisis Group, 2003. *Country Report Pakistan.* Retrieved on June 21 2010, International Crisis Group.
On web: http://www.crisisgroup.org/home/index.cfm/id=3100andl=1

Javaid, U. 2010. "Corruption and its Deep Impact on Good Governance in Pakistan" *Pakistan Economic and Social Review* 48(1): 123-134.

Kaufmann, D., K. Aart and Z. L. Pablo, 1999. *Governance Matters.* World Bank Policy Research Working Paper No. 2196.

Khan, M., N.A. Kakakhel and M.J. Dubnick 2004. "Prosecuting Corruption: The Case of Pakistan" *Ethics Forum, American Society for Public Administration*, Portland.

Khattak, S., S. Rehman and S. Shafqat, 1999. *Perspectives on Corruption in Pakistan, a pilot study.* Sustainable Development Policy Institute.

Kuncoro, A. 2006. "Corruption and Business Uncertainty in Indonesia." *ASEAN Economic Bulletin* 23(1): 11-30.

Lui, F. T. 1985. "An Equilibrium Queuing Model of Bribery" *The Journal of Political Economy* 93(4): 760-781.

Mauro, P. 1995. "Corruption and Growth." *Quarterly Journal of Economics* 110(3): 681-712.

Mauro, P. 1996. *The Effects of Corruption on growth, Investment and Government Expenditure: A Cross-Country Analysis*. Institute for International Economics: Washington D.C.

NAB, 2002. *National Accountability Ordinance Summary.* Retrieved June 05, 2010, from National Acountability Bureau. On web: http://www.nab.gov.pk/Downloads/nao.asp

NAB, 2010. *Annual Report, 2010.* National Accountability Bureau: Pakistan

Olken, B. A. 2009. "Corruption perceptions vs. Corruption reality." *Journal of Public Economics* 93(*7*): 950-964.

Pope, J. 2002. *Confronting Corruption: the Elements of a National Integrity System*. Transparency International: Berlin

Rahman, N. 2003. *National Integrity Systems, Contry Study Report Pakistan.* Transparency International: Pakistan

Raza, M. 2007. October 8. "Lapses in Anti-Money Laundering Law." *Dawn Economic and Business Review* .

Raza, M. 2008a. November 03. "Time to Restructure the Economy." *Daily Dawn*.

Raza, M. 2008b. "What Corruption Costs the Nation." *Pulse Weekly* .

Rehman, S. 2000. *Who Owns Pakistan.* Harper Collins Publishers India Pvt. Limited: Delhi

Rose-Ackerman. 1997. "The Political Economy of Corruption." On web: http://www.iie.com/publications/chapters_preview/12/2iie2334.pdf

Samad, S. 2008. "Combating corruption: The case of the National Accountability Bureau, Pakistan" *JOAAG* 3(1): 90-100.

Sethi, N. 2005. Interview, The Blue Chip 2: 54-56.

Tanzi, V. and H. R. Davoodi 1997. *Corruption, Public Investment, and Growth.* IMF Working Paper 97/139 .

Tanzi, V. 1998. *Corruption Around the World: Causes, Consequences, Scope, and Cures.* Staff Papers-International Monetary Fund.

The Daily Dawn, 2010. September 25. "A-G Report Unearths Massive Irregularities in Pakistan's Defence Expenditure" *The Daily Dawn* .

Transparency International, 2002. *The Corruption Survey Report.* Geneva: Transparency Interanational.

Transparency International, 2008. *Working Paper No. 2/2008 Poverty and Corruption.* Transparency International: Geneva

Transparency International, 2009. *Global Corruption Report 2009: Corruption and the Private Sector.* Cambridge University Press: Cambrdige

Weber, A. C. 2007. *How Much Do Perceptions of Corruption Really Tell Us?* Economic Discussion Papers.

World Bank, 2006. *Pakistan Country Assistance Evaluation.* Country Evaluation and Regional Relations Independent Evaluation Group.

World Economic Forum, 2010. *Full Rankings Global Competitiveness Index 2010-11*. Retrieved September 15, 2010, World Economic Forum: On web: http://www.weforum.org/documents/GCR10/Fullpercent 20rankings.pdf

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Foreign Direct Investment and Domestic Savings in Pakistan

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Abstract: This study examines the impact of foreign direct investment (FDI) on domestic savings in Pakistan using the data for the period 1975 to 2008. The objective of this study is to find out whether FDI, when its impact is segregated from other components of foreign capital inflows, has supplemented or crowded out domestic savings in Pakistan. The methodology used for estimation of results in this study is Johansen Co-integration and Error Correction Model. The results of the present study indicate that foreign direct investment has crowded out domestic savings while the foreign aid, another component of foreign capital, has supplemented domestic savings in Pakistan during the period under investigation. In view of the findings of this study it has been recommended that FDI should be encouraged in the capital producing sector of the economy to avoid its crowding out effect.

Keywords: Foreign Direct Investment, Savings
JEL Classification: F21, E21

1. Introduction

Savings can be generated by a country at home or it can acquire the savings made by residents of the other countries. Savings mobilized at home are known as domestic savings while those obtained from other countries are known as foreign savings. Foreign savings can be categorized into two basic forms i.e. foreign aid and foreign direct investment. Foreign aid is basically the flow of resources on either bilateral basis i.e. from government of one country to the other or on multilateral basis in which case some multilateral institution e.g. World Bank or IMF provide the necessary resources to the recipient country. As far as foreign investment is concerned it is taken up by the multinational corporations.

Foreign Direct Investment (FDI), one of the components of foreign capital inflows, plays an important role in the economic development of a country and the developing countries like Pakistan make all possible efforts to attract FDI on the grounds that it provides the scarce resources

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which developing countries usually lack. However, the question which needs an answer is that whether the inflow of such resources enables the developing country, in the long run, to generate its own resources domestically and reduce its reliance on foreign capital inflows. This is possible if FDI augments domestic savings of a developing country. Therefore, the purpose of this research paper is to investigate as to whether the inflow of foreign direct investment has crowded out or supplemented domestic savings in Pakistan.

The structure of this paper consists of introduction in the first part; second part consists of literature review, third part explains methodology and data analysis and conclusion is given in the fourth part.

2. Literature Review

The theoretical foundation of the link between foreign capital and domestic savings can be traced back to the Harrod-Domar growth model and the dual gap model of Chenery and his collaborators. These models, also known as gap models, highlight the importance of foreign capital in filling the saving-investment and trade gaps in the economy of developing countries.

The empirical research so far done on the relationship between foreign capital inflows and domestic savings has produced conflicting results. Some studies have shown positive impact of foreign capital inflow on domestic savings (Chenery and Strout, 1966; Gulati, 1978) while others have found that foreign capital inflow has depressed the domestic savings of the recipient countries (Griffin and Enos, 1970; Papanek, 1973; Ahmad and Qazi, 2002). There are other studies which did not find any significant relationship between foreign investment and domestic savings (Dhar and Roy, 1996). Therefore, there is lack of consensus regarding the impact of foreign capital on domestic savings which calls for further investigation. Moreover, most of the research on current issue suffers from aggregation problem as well i.e. of treating the foreign capital at aggregate level instead of disaggregating it into its components (e.g. foreign investment, foreign aid, grants etc.)

The empirical studies, which found positive impact of foreign capital, concluded that foreign capital supplemented domestic savings by

providing additional resources for investment to the recipient countries. On the other hand, the studies which established negative relation between foreign capital and domestic savings argued that the inflow of foreign capital slackened the efforts of the recipient government to mobilize domestic resources.

The research done on this topic has, in most cases, proved that foreign capital has negatively affected domestic savings in Pakistan. However, the former studies suffer from some shortcomings. Most of these studies (Weisskopf, 1972; Aslam, 1987; Khan *et al.* 1992 and Khan and Rahim, 1993) applied regression analysis without checking for the stationarity property of the time series data. Since, time series data are most of the time non-stationary, the findings of these studies cannot be taken as reliable ones. There is only one study relating to the current topic on Pakistan economy which took into account the stationarity property of data (Ahmad and Qazi, 2002). However, this study also did not segregate the impact of FDI from other components of foreign capital inflows. The effect of foreign capital on domestic savings can vary when considered at aggregate level and/or at disaggregate level i.e. in form of its components like foreign aid, foreign direct investment etc.

Therefore, the contribution of the present research paper is that it will segregate the impact of foreign direct investment from its other components of foreign capital inflows and will apply the appropriate time series technique for estimating the relationship between FDI and domestic savings in Pakistan.

3. Methodology and Data Analysis

To examine the impact of foreign direct investment on domestic savings in Pakistan time series data for the period from 1975 to 2008 has been collected from the Handbook of Statistics on Pakistan Economy and the Economic Survey of Pakistan (Government of Pakistan, 2010). The variables included in the study are domestic savings, gross domestic product, foreign direct investment and foreign aid. All the variables in the study have been transformed into natural logarithms.

The following theoretical model is specified to analyze the impact of FDI on domestic savings in Pakistan:

$$LnS_t = \beta_0 + \beta_1 LnY_t + \beta_2 LnFA_t + \beta_3 LnFDI_t + E_t \quad (1)$$

where Ln= natural logarithm, S= Domestic Savings, Y= Gross Domestic Product, FA= Foreign Aid, FDI= Foreign Direct Investment and E_t= Stochastic Error Term of the Equation.

3.1 Unit Root Test

Since time series variables are most of the time non-stationary, first of all stationarity of the variables has been checked through Augmented Dickey-Fuller (ADF) test. The results of Augmented Dickey-Fuller are given in Table 1.

Table 1: Augmented Dickey-Fuller (ADF) Test

Variables	level		1st Difference	
	With Intercept	With Intercept and Trend	With Intercept	With Intercept and Trend
LDS	-1.24	-2.48	-6.45	-6.37
LGDP	-0.54	-3.03	-5.25	-5.20
LFA	-0.41	-1.29	-8.27	-8.12
LFDI	-0.17	-3.98	-7.65	-7.62
Critical Value at 1percent	-3.65	-4.26	-3.65	-4.27
Critical Value at 5percent	-2.95	-3.55	-2.95	-3.55
Critical Value at 10 percent	-2.61	-3.21	-2.61	-3.21

Source: Author's own calculations.

The results of ADF test show that the variablesare stationary at first difference. Therefore, it can be conclude that the variables are integrated of order one. Having confirmed that all the variables are integrated of the same order, the next step is to check whether there exists a long run relationship among the variables using cointegration analysis.

3.2 Johansen Cointegration

Johansen Cointegration methodology is used to test for long run relationship among the variables. Under Johansen Cointegration the long run relationship is checked through the following two tests:

- Trace Test
- Eigenvalue Test

These tests are performed sequentially. At the first stage we test the null hypothesis that there are at most 0 cointegrating equations, which means that long run relationship does not exist. Then we move on to test the null hypothesis of 1 , 2 and more cointegrating equations. The criterion for checking the long run relationship or cointegration is that the calculated values of both these tests are compared with the critical values. If the calculated values exceed the critical value, we reject the null hypothesis and conclude that cointegration exists. The Johansen Cointegration results are given in Tables 2 and 3.

Table 2: Trace Test Results

Hypothesized No. of C.E.(s)	Trace Statistic	0.05 Critical Value	P Value
None *	51.80288	47.85613	0.0203
At most 1	17.41719	29.79707	0.6092
At most 2	4.992256	15.49471	0.8096
At most 3	0.072181	3.841466	0.7882

Source: Author's calculations

* indicates rejection of the hypothesis at the 0.05 level.

The results of both the trace test and eigenvalue test indicate that one cointegrating equation exists. Since it is a sequential test, we first test the hypothesis of no cointegration against the alternative hypothesis of at most one cointegrating equation. As shown in Table 2 and 3, both the trace test statistic and the eigenvalue test statistic are greater than the critical values at 5 percent (i.e. trace statistic of 51.80288 against the critical value of 47.85613 and max-eigenvalue of 34.38569 against the critical value of 27.58434).

Table 3 : Eigen-Value Test Results

Hypothesized No. of C.E.(s)	Maximum Eigenvalue Statistic	0.05 Critical Value	P Value
None *	34.38569	27.58434	0.0057
At most 1	12.42493	21.13162	0.5063
At most 2	4.920075	14.26460	0.7519
At most 3	0.072181	3.841466	0.7882

Source: Author's Calculations

* indicates rejection of the hypothesis at the 0.05 level.

Therefore, we reject the null hypothesis of no cointegration against an alternative hypothesis of at most one cointegration. Then we move on to test the null hypothesis of at most one co-integrating equation against the alternative hypothesis of at most two cointegrating equations. The null hypothesis of at most one cointegrating equation cannot be rejected because the calculated values of both the tests are less than the critical values at 5percent (i.e. trace statistic of 17.41719 against the critical value of 29.79707 and max-eigenvalue statistic of 12.42493 against the critical value of 21.13162). Thus, it is concluded that there is one cointegrating equation i.e. long run relationship exists among the variables.

So far we have established that all the variables of this study are integrated of the same order (i.e. integrated of order one) and a long run relationship exists among them. The prerequisites for estimating a Vector Error Correction Model are that all the variables should be integrated of the same order and they should be cointegrated as well. Since both these conditions are fulfilled, the next step is to estimate Vector Error Correction Model (VECM).

3.3 Vector Error Correction Model

The Vector Error Correction Model (VECM) reports both the long run estimates of the model as well as the short run deviations from the long run equilibrium through error correction term. First, we discuss the long run estimates of our model. The long run coefficient estimates along with their t-values in parenthesis are given below:

$$LDS_t = -18.23 + 1.522LGDP_t + 1.462LFA_t - 0.809LFDI_t$$

(-7.701) (-7.576) (5.956) (2)

The estimated coefficients in the above equation denote the long run elasticity of domestic savings (S) with respect to GDP, foreign aid and foreign direct investment. The results show that one percent increase in FDI leads to 0.809 percent reduction in domestic savings whereas one percent increase in foreign aid raises domestic savings by 1.462 percent. Thus, according to the estimates, the impact of FDI on savings is negative. The negative impact of FDI on domestic savings is due to the fact that a major portion of FDI in Pakistan comes in consumer goods e.g. telecommunication, banking and food and beverages etc. When FDI is directed towards consumer goods it definitely encourages consumption and ultimately depresses savings. With regards to the other component of the foreign capital inflow i.e. foreign aid, its impact on domestic savings has been found to be positive. As expected the relationship of GDP with the dependent variable savings is also found to be positive i.e. one percent increase in GDP will raise the domestic savings by 1.522 percent.

After examining the long run results, the short run dynamics are captured by VECM. The most important thing to be observed in VECM model is the error correction term which indicates the speed of adjustment of the short run deviations towards the long run equilibrium. The value of error correction term (ECT) in our model is -0.238220. The negative sign of ETC term indicates that the disequilibrium in the short run will converge towards the equilibrium position in the long run and the period it will take for converging toward the long run equilibrium can be calculated as under:

$$1/\ 0.238220=4.1978$$

So, if disequilibrium occurs in the model the same will be corrected in a period of approximately 4 years.

3.4 Parameter Stability Test

The stability tests are performed to check whether the long run and short run relationships estimated by our model remain stable for the entire period of study. The parameter stability is assessed through the cumulative sum (Cusum) test and the cumulative sum of squares

(Cusumq) test. If the graphs of Cusum and Cusumsq remain within the 5 percent critical bounds, it is concluded that the parameters are stable. However, if the plots of Cusum and Cusumsq cross any of the parallel lines the null hypothesis of parameter stability is rejected at 5 percent level of significance. The graphs of Cusum and Cusumsq are presented in Figure 1 and Figure 2, respectively (Appendix-A). In both the graphs, the plots of Cusum and Cusumsq stay within the 5 percent critical bound. It indicates that there is stable long run relationship among the variables namely domestic savings, GDP, foreign aid and foreign direct investment. Thus, we can conclude that parameters of our model remain stable for the entire period of study and the results are appropriate for policy recommendations.

4. Conclusions

The present research has examined the impact of FDI on domestic savings in Pakistan, at disaggregate level, and it has been found that FDI negatively affects domestic savings in Pakistan. The negative effect is due to concentration of FDI in consumer goods sectors. FDI is chiefly concentrated in telecom, financial business and food and beverage sectors. All these groups of FDI are engaged in provision of consumer goods/services which raises the consumption level of the people. Since FDI tends to raise consumption, it ultimately depresses savings. Therefore, it is recommended that Foreign Direct Investment should be encouraged in capital producing sector as well because in this way we can produce the infrastructure required for further development of the country. Moreover, if FDI comes in the capital producing sectors, then its impact on savings will be positive.

References

Ahmad, M. H. and M.A. Qazi 2002. "Foreign Capital Inflows and Domestic Savings in Pakistan: Cointegration Techniques and Error Correction Modelling" *The Pakistan Development Review* 41(4-2): 825-836.

Aslam, N. 1987. "The Impact of Foreign Capital Inflow on Savings and Investment: The case of Pakistan" *The Pakistan Development Review* 4(26): 787-789.

Chenery, H. and S. Strout, 1966. "Foreign Assistance and Economic Development" *American Economic Review* 66(4-1): 679-753.

Dhar, B. and S. S. Roy 1996. "Foreign Direct Investment and Domestic Savings-Investment Behavior: Developing Countries' Experience" *Economic and Political Weekly* 31(35/37): 2547-2551.

Government of Pakistan, 2010. *Handbook of Statistics on Pakistan Economy 2010*. State Bank of Pakistan, Karachi.

Griffin, K. and J. Enos 1970. "Foreign Assistance: Objectives and Consequences" *Economic Development and Cultural Change* 18(3): 313-327.

Gulati, U.C. 1978. "Effects of Capital Imports on Savings and Growth in Less Developed Countries" *Economic Inquiry* 16: 563-569.

Khan, H. A., L. Hasan and A. Malik, 1992. "Dependency Ratio, Foreign Capital Inflows and the Rate of Savings in Pakistan." *The Pakistan Development Review* 31(4): 843-856.

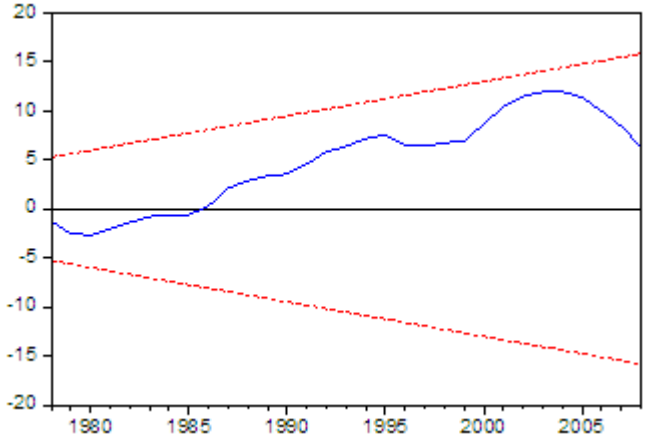
Khan, N. Z. and E. Rahim, 1993. "Foreign Aid, Domestic Savings and Economic Growth (Pakistan: 1960 to 1988)" *The Pakistan Development Review* 32(4): 1157-1167.

Papanek, G.F. 1973. "Aid, Foreign Private Investment, Savings and Growth in Less Developed Countries." *Journal of Political Economy* 81(1): 120-130.

Weisskopf, T. 1972. "The Impact of Foreign Capital Flows on Domestic Savings in Underdeveloped Countries." *Journal of International Economics* 2(1): 25-38.

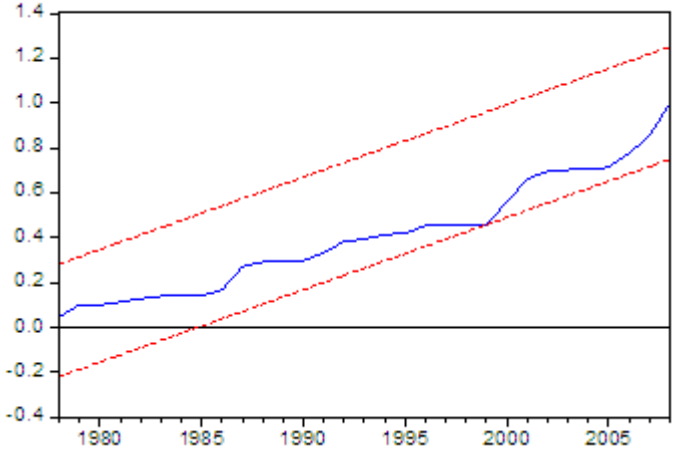
Appendix-A

Figure 1: Cusum Graph for FDI and Domestic Savings in Pakistan



Source: Authors own calculations at 5 percent significance.

Figure 2: Cusum sq Graph for FDI and Domestic Savings in Pakistan



Source: Authors own calculations at 5 percent significance.

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An Analysis of Determinants of Child Labour: A Case Study of Petrol Stations in Lahore

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Abstract: The paper aims to investigate the variables that are a cause of child labour, by studying this phenomenon in case for Lahore. A questionnaire was developed and a survey of 103 registered petrol stations was conducted in a time horizon of one month. These petrol stations have adjacent tyre shops which employ children for work. Each question was based on a sound literature review, so that any important aspect or variable which has an impact on the issue of child labour must not be omitted. The results were later organized and when, interpreted suggested that the prime factors for children working at these tyre shops were similar to the ones highlighted under empirical studies. Analysis suggested that children worked more than usual working hours without any medical aid leading to a negative impact on their mental and physical health. Still these child workers remained unable to contribute properly for enhancing their families' monetary funds. Poor financial and economic resources termed as poverty, large family size and illiteracy stood out to be the prominent among other variables as a cause of this menace.

Keywords: Rice Price Policy, Basmati, IRRI, acreage, yield
JEL Classification: 060, L6

1. Introduction

According to international estimates, around 211 million children across the world can be accounted for under child labour.[1] The definition that is used globally to define child labour is any economic activity performed by a person under the age of 14 years.[2] These people are often exploited, forced or compelled to work mentally, sexually, and physically at this age. The issue of child labour seems to generate more concern in the case of developing economies, where majority of the population is below poverty line or leading a life of subsistence. These children, due to unfortunate

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[1] This accounted for a little less than one fifth of all children between 5 and 14 years old.

[2] See International Labour Organization (ILO, 1996). From country to country the age for child labourer may vary.

socio-economic conditions and other contributing factors, are pushed into work at an early age. They are compelled to work for longer hours and in poor work environments, leading to negative impact on their mental and physical health.

As Pakistan is a developing economy with a huge population pressure (Government of Pakistan, 2010), the menace of child labour is prevalent in many areas of the economy. The theme of the paper is to investigate the set of factors that cause child labour; it uses a case study of the children working at the tyre shops adjacent to petrol stations in the city of Lahore. The paper begins with highlighting the empirical studies in the relevant area and later, with the help of a questionnaire, identifies the specific variables that result in children falling prey to child labour at a young age. The analysis reveals factors similar to those mentioned in literature as major contributors to child labour.

2. Literature Review

Burra (1987), in his study regarding child workers employed on hand presses, reveals that almost 50 percent workers were children and they were officially below the labour force age limit. Hazardous work performed by these children has an adverse effect on their health and the wages given are not even enough to purchase the basic necessities. Another study in this field suggests that variables such as income, poverty, socio-economic inequality and school enrolment have a considerable impact on child labour levels in the economy. The study suggests that the goal of abolition of child labour is beyond the immediate reach of most countries (Ahmed, 1999).

Data set of child labour for Peru and Pakistan employed by Ray (2000), shows income and related economic variables bear a significant impact on children's work input. Peruvian children have greater experience of schooling than Pakistani counterparts. Both countries agree on improving education and investing in infrastructure, as these play a vital role in discouraging child labour.

Antony and Gayatheri (2002), describe the issue of child labour in India. They suggest that the child labour phenomenon is linked to the social

construct of the society along with variables such as lack of education, infrastructure for investment, social status and types of occupation available in the society. Jabari *et al.* (2005), describe that child labour is a multi-generation problem which is due to the failure of education. Child labour further aggravates issues such as nutritional deficiencies, poverty and poor health of workers involved. Child labour and nutrition are important issues in both education attainment and health status. The article also shows how maternal health has an impact on children health and how initiatives to improve health and welfare of women and children can be integrated into multidisciplinary efforts to eliminate child labour. Roelen and Gassmann (2008), describe in their research that reduction in child poverty as a short-term objective can lead to reduced adult poverty in long term. Indian carpet industry in Mirzapur and Badohi in UP is the third largest earner of foreign exchange; hand knotted carpet industry involves a huge number of child labourers. The major hurdles in reducing child labour in these areas are poverty and illiteracy (Ravi, 2001).

Studies conducted in this area highlight the role that international organization can play to eliminate child labour across the world. International Labour Organization and World Bank are among many organizations that are working to eliminate child labour. But many a times their actions do not get a global positive response, thus, endangering the precious gift of childhood for many children across the globe (Remington, 1996). A study by Basu and Van (1998), highlighted that according to Bureau of Statistic of ILO, around 120 million children around the globe, aged between 5 and 14 years of age, did fulltime work. They took a sample of different countries such as; England, India, Japan US etc and suggested that child labour increased in early 19^{th} century and started declining in the late 19^{th} century. They distinguish three kinds of interventions and institutions. The first being intra-national: It consists of laws that country enacts and interventions that it plans in order to control child labour within national boundary. The second in this category is, supra-national: Interventions by international organization such as WTO, ILO and etc. Lastly, extra-national: Interventions, those in which developed countries took legislation and action to curb child labour in developing nations.

3. Data and Methodology

After conducting literature review, variables that have an impact on child labour were identified. In order to find out whether the variables mentioned in the empirical studies effect child labour at petrol stations in Lahore, a questionnaire was developed. This questionnaire covered almost all the aspects considered vital in playing a role in either aggravating or reducing the menace of child labour. A total of 27 questions were developed which were later analysed to highlight reasons or determinants of child labour in Lahore with regards to petrol stations. Selection criterion for petrol stations was the stations that were registered by the relevant government licensing authority. A total of 103 petrol stations were registered by four major petroleum companies; Pakistan State Oil, Shell, Caltex and Total Parco.

During the survey in which questionnaires were filled, it was found that 6 stations were not at their actual location and 3 were closed due to reasons unknown. Among these stations child labour existed at only 71 petrol stations. These child labourers are usually present not at the stations for fuelling purposes, but are employed at the adjacent tyre repairing shops. The questionnaire was answered by more than 90 respondents and they were child labourers according to the definition employed by International Labour Organization.[3]

In order to process the information received, statistical package of SPSS and Microsoft Excel were employed. The data included variables such as age, weight, number of family members, number of rooms in the house, number of family members earning etc. Other variables such as sources of family income, affordability of schooling, literate parents, and monthly expenditures on various heads were among many in the list of 27 questions developed. The information gathered was organized in the form of pie, line and bar charts. Information was further assessed by calculating mean, median, mode, frequency tables and standard deviations, each generating a link between the determinants of child labour.

[3] See official Website for ILO.

4. Data Analysis

The analysis of the data is done by grouping similar and related questions under the following sub headings:

4.1 Age and Family size

The first question pertains to the age of the child labourer for which two class groups were formulated. A total of 10.5 percent of the respondents lie among the first group of age limit of 5-10 years, whereas majority of 89.5 percent respondents fell in the second age group of 11-16 years. According to ILO (1996) estimates, "The number of working children between the ages of 5 and 14 in developing countries is estimated at 250 million, of whom some 120 million work full-time" (ILO, 1996); larger the family size, the greater is the financial pressure on the head of the family. This large family size forces the parents to push their children into work at a young age.

As it can be seen from Table 1, except for one respondent, the majority have a large family size of up to 11 family members. Around 78 child workers have family size ranging from 4-9 members; with 20 respondents having a family size of 8 members. Among these family members are usually children who are dependent upon their parents for food, clothing and shelter. Out of 95 children 90 have more than 3 children at home; some families also have as many as 9 children.

This clearly indicates that family planning methods are not commonly applied, thus increasing family size. This leads to a greater family pressure for fulfilment of basic needs. Not only the number of children is high in these families but at the same time most of the children are from age 5 to 15 years of age. Almost 50 percent of the child workers responded that they have on average 5 children below the age of 15 years.

Table 1: Frequencies and Percentage of Family Members

Sr. No.	Family Members	Frequency	Percentage
1	3	1	1.1
2	4	4	4.2
3	5	11	11.6
4	6	17	17.9
5	7	18	18.9
6	8	20	21.1
7	9	12	12.6
8	10	8	8.4
9	11	4	4.2
	Total	95	100.0

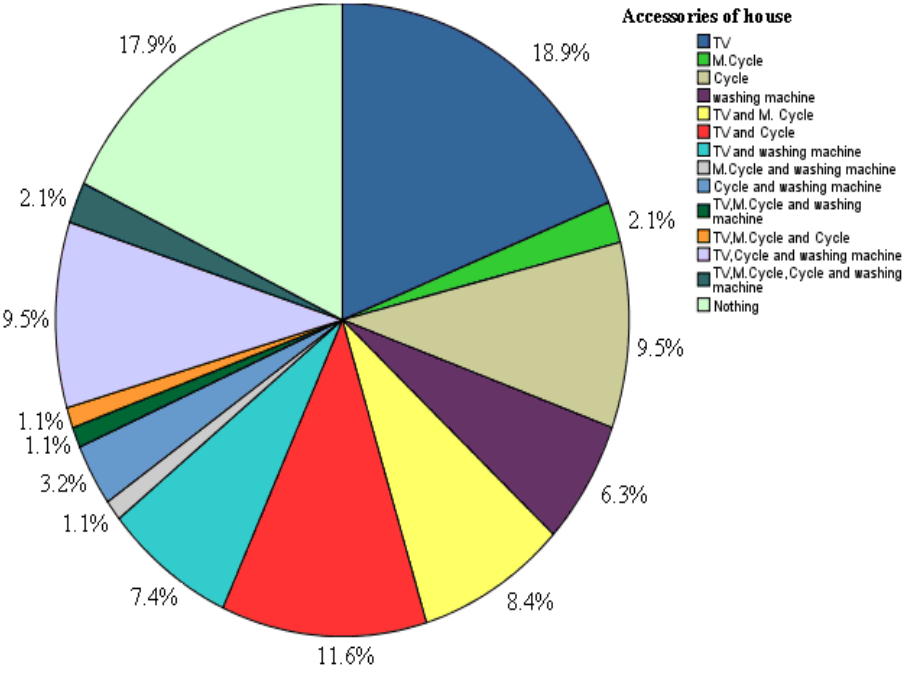
Source: Authors' own calculations

4.2 Household Attributes

Due to the financial constraints and lack of availability of proper housing, the poor are forced to share even a small house with more than one family, who might be a close relative or friend; this can lead to reduced financial burden. In the survey conducted, 75.8 percent of the child labourers said that they are a single family household, whereas 16.8 percent replied that they are 2 or 3 families living in physical vicinity. Therefore, it can be suggested that large family size is not a prime cause for children to join labour force at an early age. When asked whether these child labourers live in their own house or rented ones, 57.9 percent were living in their own houses, whereas 42.1 percent were rent payers. Those who have moved as a family from a rural setting do not own their own homes and are forced to live in rented houses. However, due to the limited financial resources, the size of the house is very small. This is evident from the figures collected on the number of rooms that are in the houses occupied by these child workers. Around 43.2 percent of these workers live in a small two-room house. The average size of the house is also two rooms; very few respondents have houses with more than 4 rooms.

As these families are barely managing their everyday lives, they do not have many household items which now a days are considered as necessities. From the pie chart below it can be seen that 17 percent of the families do not even have a television or any of the mentioned accessories at home. Only a few have bicycled and even fewer own a motorcycle. This indicates that they are dependent upon public transport for everyday travelling.

Figure 1: Pie Chart for Accessories of House



Source: Authors' own compilation.

4.3 Financial and Economics Status

Financial status of the family was investigated by finding out the number of earning persons in a family; 41.1 percent of the respondents have only 2 earning members. Large family size along with few wage earners results in greater dependency ratios for developing economies like Pakistan. The data suggests that around 50 percent of the respondents' families have a total monthly income below Rs. 10,000. As the parents remain unable to

meet the everyday expenses of life, the children are forced to start working at a young age in order to support their family. Data collected suggests that 31.7 percent of these child labourers have 2 to 4 children in their family who are employed in other activities to support their families.

The parents defend the act of sending these children to work on the ground that they are improving the financial resources of the family. The question asked was, "If these children are removed from work and sent to schools what effect will it have on their families' financial and economic status?" Data highlights that that 84.2 percent of the children agree to the decision taken by their parents whereas rest say that no significant improvement has taken place in their families' income levels due to their early work practice.

4.4 Educational Activities

Literacy rate of Pakistan is 57 percent and the total expenditure on education is 2.1 percent of GDP (Government of Pakistan, 2010). These figures show a bleak picture of our society with respect to development of human resource. Figures reveal that 35.8 percent of the families of the respondents do not even send one child to school and only 18.9 percent of the families send at least one child to school. This clearly indicates that education is not at all a priority for these children. The simple rationale for not sending their children to school is affordability. The data indicates that almost 42.1 percent of the families of the respondents take education as an additional/burdensome expenditure. Due to low income and larger family size, education is considered an investment that is out of reach for these families. Poverty turned out to be the prime reason for not sending the children to school, as 67.4 percent of the families suggested this reason. Table 2 reveals that even if the children are sent to schools the expenditures on their education are very low.

According to the International Labour Organization, it has been observed that poverty is almost always a context for the early entry of children into regular work and child labour. Poverty can also be a function of a) access to labor markets and income-raising activities; b) family members of working age not having appropriate skills to match market needs in the area where they live; c) low educational levels of family members; d)

unemployment in the area where the family lives and e) conflict, illness or natural disaster having taken away the bread-earner of the family leaving a dependent household with no-one to depend on.

Table 2: Frequency and Percentage of Monthly Expenditures of Schooling

Expenditures	Frequency	Percentage
Less than Rs 100	8	8.4
Between Rs 100 and Rs 300	8	8.4
More than Rs 300	54	56.8
No Expenditures	25	26.3
Total	95	100.0

Source: Authors' own calculations.

These children remain illiterate for another reason as well: the illiteracy of the parents themselves. In the case of child labourers working at petrol stations in Lahore, 56 out of 95 respondents said that both the parents were illiterate. Studies indicate that the illiteracy of parents leads to an increase in child work participation and the effects are greater on female children than male.

4.5 Health and Hygiene

In order to contribute to the economic status of the family, these children are working in environments which are unhealthy and unhygienic. This poor work environment becomes a cause of concern with regards to the health of the children. When inquired about the impact that the working environment has on the health, 74.7 percent replied that the effect was negative. This poor work environment leads to health problems such as cough, fever, body pain, cold and at times other severe infections. The survey showed that almost 80percent of the respondents complained about some health issue. Most common health problems were fever, cold and

cough with 33.7 percent, 20 percent and 13.7 percent replies respectively. Medical aid or facilities are not present at the petrol stations, nor do the owners provide any kind of medical allowance; the families themselves are so poor that access to health facilities is out of their reach. Around 71.6 percent of the children working at these tyre shops said that no health facility, not even first aid, was available in case of any emergency at the working area.

Poor health expenditure by the Government of Pakistan of a mere 0.54 percent of GDP makes health and hygiene facilities inaccessible to the underprivileged masses (Government of Pakistan, 2010). The data about the monthly medical expenditures made by these child workers suggested that health is a non-priority area. Approximately Rs. 300/month are spent on health related expenditures by 52.6 percent of these workers; with inflation reaching double digits, this amount seems to be insignificant and meaningless.

4.6 Recreation and Extracurricular Activities

Most of these children have long hours of work and seldom get time to indulge in recreational activities. When inquired about what they do in their spare time, 57.9 percent replied that they play at home or with their friends. Very few have the financial resources to indulge in other activities such as going to theatre or cinema, so the other form of entertainment is watching television at home (if available). These figures suggest that the children in our survey are physically as well as mentally deprived of any recreational activities and remain this way due to conditions of extreme poverty.

5. Conclusions

Pakistan has a high population growth rate of 2.1 percent with a provisional growth rate of 4.1 percent (Government of Pakistan, 2010). This suggests that most of the families like that of the child labourers interviewed for this study remain under pressure due to large family sizes and poor economic outlets to enhance their financial resources. Even though the government has launched massive programmes to reduce family size, yet large families prevail, especially in the poorer strata of the

society. This suggests that the large family size with higher number of dependents is one of the reasons for pushing children into work at an earlier age. However, the issue of poverty is seldom resolved this way. As the respondents mentioned, their earnings do not make a significant contribution in improving the living standards of their families. If this statement is to be related to the macro economic scenario of Pakistan, the figures for poverty in Pakistan suggest that no significant improvement in poverty reduction has been seen as the change in poverty is in positive figures (Government of Pakistan, 2010).

Poor families remain unable to procure health and hygiene facilities. As indicated in empirical studies and later substantiated by the survey data, health expenditures are a negligible share of the respondents and their families' income. Parents of these child labourers are uneducated, thus educational expenditures for children of these families are not a priority. Both health and education have remained least priority areas when it comes to social sector development in case of Pakistan[4] and unfortunately, the neglect on national level is also reflected at the micro level from the data of these families.

Many international and national non-governmental and governmental agencies are working to reduce and, eventually eliminate, the issue of child labour. But the aforementioned issues such as poverty, large family size, illiteracy and poor health, coupled with other such variables make this problem unresolvable. Poor law and order situation, high unemployment rates and inflationary pressures need to be controlled so that the adults of these families need not push their children into work at an age where education and recreation should be a priority. The study points to the possible solution that is the joint effort of various organizations from international to the basic household level by controlling and manipulating the financial, economic, social and political variables.

[4] See various issues of Economic Survey of Pakistan for a comparative over view of figures for expenditures for health and education.

References

Ahmed, I. 1999. "Getting Rid of Child Labour" *Economic and Political Weekly* 34(27): 1815-1822.

Antony, P. and V. Gayathri, 2002. "Child Labour: A Perspective of Locale and Context" *Economic and Political Weekly* 37(52): 5186-5189.

Basu, K. and P. H. Van 1998. "The Economics of Child Labour" *The American Economic Review* 88(3): 412-427.

Burra, N. 1987. "Exploitation of Child Workers in Lock Industry of Aligarh" *Economic and Political Weekly* 22(28): 1117-1121.

Government of Pakistan, 2010. *Economic Survey of Pakistan.* Ministry of Finance, Pakistan (various issues).

ILO, 1996. "Child Labour: Targeting the Intolerable" *Report VI (1) International Labour Conference*, 86th session, 1998, Geneva.

Jabari, L. A., L. D. Parker and C. Oberg 2005. "Child Labor, Gender, and Health" *Public Health Reports* 120(6): 642-647.

Ravi, A. 2001. "Combating Child Labour with Labels: Case of Rugmark" *Economic and Political Weekly* 36(13): 1141-1147.

Ray, R. 2000. "Analysis of Child Labour in Peru and Pakistan: A Comparative Study" *Journal of Population Economics* 13(1): 3-19.

Remington, F. 1996. "Child Labour: A Global Crisis without a Global Response" *Economic and Political Weekly* 31(52): 3354-3355.

Roelen, K. and F. Gassman 2008. "Measuring Child Poverty and Well-Being: a literature review" *Working paper: MGSoG/2008/WP001* Maastricht University, Maastricht Graduate School of Governance.