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DEPARTMENT OF ECONOMICS

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(A Chartered University)

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Testing the Law of One Price: A Comparison between Pakistan and Australia

Farzana Naheed Khan and Eatzaz Ahmad[1]

Abstract

The paper tests the validity of the Law of One Price (LOP) for Pakistan and Australia, where primary commodities constitute a substantial part of these countries' exports. This paper conducts co-integration analysis to determine the validity of the LOP in the long run. The study deals with the relative purchasing power parity approach to the analysis of exchange rate and relative prices, and covers the period from 1972-1997. The study documents the evidence generally supportive of the law.

I. Introduction

The Law of One Price (LOP) is one of the fundamental ideas in economics, particularly in international economics. Classical purchasing power parity (PPP) is based on the LOP. The law of one price states that in the absence of transportation and other transaction costs, competitive markets will equalize the price of an identical good between two trading countries when prices are expressed in the same currency.

The LOP is such a fundamental and intuitive proposition that Lamont and Thaler (2003) define it as the "Second law of economics". Cournot ([1838] 1927) seemingly was the first to assert that the same commodities command the same prices. He states, "The market is entire territory of which the parts are so united by relations of unrestricted commerce that prices take the same level throughout with ease and rapidity". The purchasing power parity is based on the extension and variation of the law of one price as applied to aggregate economy.[2]

There is a huge literature concerned with the testing of the LOP. Among the early studies to document the size and volatility of LOP deviations

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[1] *The authors are Assistant Professor and Professor at the Department of Economics, Quaid-i-Azam University, Islamabad, respectively.*

[2] *The validity of the LOP is essentially a sufficient condition for the PPP to hold, though PPP may hold by condition even if LOP is violated for a few goods.*

across seemingly highly traded goods are Isard (1977) and Richardson (1978). Giovannini (1988) concluded that LOP deviations are highly correlated with exchange rate movements. Rogoff (1996) found that for some highly traded commodities the law of one price holds very well.[3]

Pippenger (1993) examined the long run relationship between exchange rate and Wholesale price index (WPI) using co-integration analysis. The study found that for a majority of Swiss exchange rates examined, PPP holds as a long-run equilibrium condition.[4] Pedroni (2001) employed fully modified OLS and dynamic OLS for testing the hypothesis in co-integrated panels. The study found no support for the PPP hypothesis. Chen and Rogoff (2003) studied the effects of exogenous shocks on the PPP by focusing on three countries Australia, Canada and New Zealand where primary commodities constitute a substantial part of their exports. They concluded that for these economies PPP works well because now primary exports are generic, characterized by the ease of measuring them and the ability to transact them by contract.

Unfortunately, the empirical evidence regarding the law appears at best mixed. Previous work has not provided a satisfactory explanation for this situation. The researchers used various techniques to empirically test this theory and different results were obtained depending on the methodology applied. Some studies have produced evidence unsupportive of the hypothesis while other studies have indicated the validity of the hypothesis. These mixed results suggested that it is not easy to test the theory [see Sarno and Taylor (2002)]. The empirical inconclusiveness of the LOP and PPP, which is well known in the literature, to an extent that it has been regarded as the PPP Puzzle by Rogoff (1996), has motivated many researchers to return to the examination of the law of one price and the PPP.

It is worth noting that most of the studies investigated the empirical validity of the theory for major industrial countries vis–a-vis the US dollar, with some attention focused on the European countries vis–a-vis the German mark. However, only little work has been carried out in order to examine the validity of PPP for Pakistan and for Australia. The two countries have substantial trade with each other, especially from the point of view of

[3] *For a technical discussion of the literature on testing PPP, see Froot and Rogoff (1995).*
[4] *Sarno (2000) also indicates the validity of PPP in a different framework.*

Pakistan. While Pakistan is a poor country, Australia is a rich country and it is located close to Asia. The objective of the paper is to test the validity of the LOP for Pakistan and Australia where primary commodities constitute a substantial part of these countries' exports and their major trading partners are almost the same. The paper conducts a co-integration analysis of the PPP to determine the validity of the LOP in the long run. The study deals with the relative PPP approach to the analysis of exchange rate and relative prices and covers the period from 1972-1997.

The paper is organized as follow; Data are discussed in section II. Section III outlines the methodology adopted. The empirical analysis and discussion of the results are provided in section IV before concluding in section V.

II. The Data and Methodology

The paper conducts a co-integration analysis of the relative PPP to test the validity of the LOP for Pakistan and for Australia. The study examines the long run relationship between exchange rate and price indexes and covers the period of 1972 to 1997. All the data are taken on annual basis.[5]

To measure price in the home countries and trading partners three different price indices are used, namely consumer price indices (CPI), whole sale price indices (WPI), and GDP deflator. There are two main advantages to this choice. First, all the three indexes are considered to be comprehensive measures of general price level. Second, data on these price indexes are easily available for both Pakistan and Australia, and their trading partners.

The sample of trading partners is fairly comprehensive and it covers most of the international trade of the two countries under focus. The number of trading partner is 21 for Pakistan and 22 for Australia, while the average share of trading partners in total trade of each country is more than 70%. We have collected the data on the trade of the sampled countries from different volumes of International Trade Statistics. The data on price indices and exchange rates are collected from different volumes of International Financial Statistics.

The law of one price states that for any good i $P_i = E P_f$, where P_i is the domestic currency price of good i, P_f is the foreign currency price and E is the

[5] *If monthly or quarterly data were available, we could be able to trace short-term fluctuations in the real exchange rates as well.*

exchange rate defined as the home currency price of foreign currency. Simply put LOP states that once prices are converted to a common currency, the same good should sell for the same price in different countries.

The study considers the relative version of PPP.[6] It employs the Johansen's procedure to test for co-integration.[7] The following construction is based on Johansen's procedure explained in Enders (2006). The time path of exchange rate and relative price are assumed to be characterized by the following first order VEC (Vector Error Correction) system e_t denotes natural logs of nominal exchange rate measuring the price of currency j in units of currency i and r_t denotes natural logs of relative price between countries i and j.

$$e_t = a_{ee}e_{t-1} + a_{er}\, r_{t-1} + \varepsilon_{et} \qquad (1)$$

$$r_t = a_{re}e_{t-1} + a_{rr}\, r_{t-1} + \varepsilon_{rt} \qquad (2)$$

Or subtracting lagged dependent variables from the respective equations, the system can be written in matrix notation as follows.

$$\begin{bmatrix} \Delta e_t \\ \Delta r_t \end{bmatrix} = \begin{bmatrix} \pi_{ee} & \pi_{er} \\ \pi_{re} & \pi_{rr} \end{bmatrix} \begin{bmatrix} e_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{et} \\ \varepsilon_{rt} \end{bmatrix} \qquad (3)$$

where $\pi_{ee} = a_{ee} - 1$, $\pi_{rr} = a_{rr} - 1$, $\pi_{er} = a_{er}$ and $\pi_{re} = a_{re}$.

The existence of a co-integrating relationship depends on the rank of the matrix π. The necessary and sufficient condition for the existence of a co-integrating relationship is that the rank of the matrix π is equal to one. In this case, we can express the second row as a multiple of the first.

$$\Delta e_t = \left(\pi_{ee}e_{t-1} + \pi_{er}\, r_{t-1}\right) + \varepsilon_{et} \qquad (4)$$

$$\Delta r_t = s_r\left(\pi_{ee}e_{t-1} + \pi_{er}\, r_{t-1}\right) + \varepsilon_{rt} \qquad (5)$$

Now the study considers a generalized VEC model that combines the restricted VEC model with the conventional VAR model in first differences. Considering the error correction process by including an intercept and a trend term, and augmenting the VAR portion of the model by drift and linear trend

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[6] *The evidence supporting PPP proposition is always based on the validity o f LOP.*

[7] *Larsson and Lyhagen (2007) introduced a likelihood based framework for testing and estimation in co- integrated panels-vector-error correction models setting that can be seen as a generalization of the Johansen procedure.*

variations, we can write the ECVAR model as follows

$$\Delta e_t = \left[\pi_{ee} e_{t-1} + \pi_{eo} + \pi_{er} r_{t-1} + \pi_{et}(t-1)\right] + \sum_{j=1}^{p} \phi_{ee} \Delta e_{t-j} + \sum_{j=1}^{p} \phi_{er} \Delta r_{t-j}$$
$$+ \mu_e + \tau_e t + u_{et} \tag{6}$$

$$\Delta r_t = \left[\pi_{re} e_{t-1} + \pi_{ro} + \pi_{rr} r_{t-1} + \pi_{rt}(t-1)\right] + \sum_{j=1}^{p} \phi_{re} \Delta e_{t-j} + \sum_{j=1}^{p} \phi_{rr} \Delta r_{t-j}$$
$$+ \mu_r + \tau_r t + u_{rt} \tag{7}$$

The rank condition is tested by finding out the number of non-zero characteristic roots of the π matrix. Enders (2006) provides a general procedure to test the following two null hypotheses. The testable null hypothesis along with the alternative hypothesis and test statistic are given by:

$H_0^A : \lambda_1 = \lambda_2 = 0$ and $H_1^A : \lambda_i \neq 0$ *for at leat one i*

Test statistic: $\lambda_{trace}(1) = -n\left[\ln\left(1 - \hat{\lambda}_1\right) + \ln\left(1 - \hat{\lambda}_2\right)\right]$

$H_0^B : \lambda_1 \neq 0,\ \lambda_2 = 0$ and $H_1^B : \lambda_i \neq 0$ *for both i*

Test statistic: $\lambda_{\max}(1,\ 2) = -n\left[\ln\left(1 - \hat{\lambda}_2\right)\right]$

The existence of a co-integrating relationship requires that the first null hypothesis should be rejected while the second should be accepted. Following the standard convention the test will be applied under five alternative cases, which are listed below along with the implied restrictions on parameters in the ECVAR system.

Case 1: No intercept or trend in VEC and no drift or trend in VAR

Restriction:
$\pi_{eo} = \pi_{et} = \mu_e = \tau_e = 0, \quad \pi_{ro} = \pi_{rt} = \mu_r = \tau_r = 0$

Case 2: Intercept but no trend in VEC and no drift or trend in VAR

Restriction: $\pi_{et} = \mu_e = \tau_e = 0, \quad \pi_{rt} = \mu_r = \tau_r = 0$

Case 3: Intercept but no trend in VEC and drift but no trend in VAR

Restrictions: $\pi_{et} = \tau_e = 0, \quad \pi_{rt} = \tau_r = 0$

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Case 4: Intercept and trend in VEC and drift but no trend in VAR

Restrictions: $\tau_e = 0, \quad \tau_r = 0$

Case 5: No drift or trend in VEC or VAR

Restrictions: None

Although the test will be applied under all the above five options, we shall concentrate only on case 2 and case 3 for detailed analysis. For example case 1 does not have much relevance in the light of the fact that absolute version of PPP cannot be tested. Case 4 and case 5 are also not very suitable for testing relative PPP. The reason is that de-trending takes much of the long-term variations from the series and as a result the power of test to reject the null hypothesis of stationary in data is unnecessarily reduced.

When a co-integrating (or 'equilibrium') relationship between exchange rate and relative price exists, the next natural step is to study dynamic response in the two variables to deviations. In that case the ECVAR model is re-estimated for the error correction analysis by imposing the restrictions on the π matrix implied by the rank condition. The parametric restrictions to satisfy the rank condition are:

$\pi_{ro} = s_r \pi_{eo}$, $\pi_{ro} = s_r \pi_{eo}$, $\pi_{rr} = s_r \pi_{er}$ and $\pi_{rt} = s_r \pi_{et}$

The resulting ECVAR model (equation 6 & 7) can now be written as:

$$\Delta e_t = \pi_{ee}\left[e_{t-1} + \theta_{eo} + \theta_{er}\, r_{t-1} + \theta_{et}(t-1)\right] + \sum_{j=1}^{p} \phi_{ee}\, \Delta e_{t-j} + \sum_{j=1}^{p} \phi_{er}\, \Delta r_{t-j}$$
$$+ \mu_e + \tau_e\, t + u_{et} \qquad (8)$$
$$\Delta r_t = \pi_{re}\left[e_{t-1} + \theta_{eo} + \theta_{er}\, r_{t-1} + \theta_{et}(t-1)\right] + \sum_{j=1}^{p} \phi_{re}\, \Delta e_{t-j} + \sum_{j=1}^{p} \phi_{rr}\, \Delta r_{t-j}$$
$$+ \mu_r + \tau_r\, t + u_{rt} \qquad (9)$$

where $\theta_{eo} = \pi_{eo} / \pi_{ee}$, $\theta_{er} = \pi_{er} / \pi_{ee}$ and $\theta_{et} = \pi_{et} / \pi_{ee}$

If the value of error term is greater (less) than 0, it means that the exchange rate is greater (less) than the level that should prevail along the equilibrium path and/or relative price level is less (greater) than the equilibrium level. If such an error occurs in a period then under any version of PPP one would expect that in the next period the adjustments in exchange rate and price level are such that they produce tendency towards restoring equilibrium. This can happen if and only if the error correcting process satisfies the conditions:

$$\pi_{ee} D_{t-1} < \pi_{re} D_{t-1} \quad whnever\, D_{t-1} > 0 \tag{10}$$

$$\pi_{ee} D_{t-1} > \pi_{re} D_{t-1} \quad whnever\, D_{t-1} < 0 \tag{11}$$

where $D_{t-1} = e_{t-1} + \theta_{eo} + \theta_{er} r_{t-1} + \theta_{et}(t-1)$ denotes the deviation from equilibrium. The above conditions simplify to $\pi_{ee} < \pi_{re}$. Three possible patterns that are consistent with this requirement are $\pi_{ee} < 0, \pi_{re} > 0$ or $\pi_{ee} > \pi_{re} > 0$ and $\pi_{ee} < \pi_{re} < 0$.

This completes the procedure for co-integration analysis. Now the first step is to determine the existence of co-integrating relationship and at the second stage the parameters of the error correcting equation are studied to determine whether or not the PPP proposition holds.

III. Empirical Results

We now analyze Purchasing Power Parity (PPP) proposition by testing the existence of co-integrating relationships between bilateral nominal exchange rates of Pakistan and Australia with each of their trading partners and the corresponding relative price. Johansen's test is applied on the null hypothesis H_0^A and H_0^B to determine the number of co-integrating vectors with $\lambda_{trace}(1)$ and $\lambda_{\max}(1, 2)$ statistics.

The crucial information that comes out of this exercise is about the number of characteristic roots that are significantly different from zero (equal to the number of co-integrating vectors), which in the present context can vary from zero to two. This information is given by table 1 and table 2 focusing mainly on case 2 and 3 and considering three price indices utilized. There are 132 potential co-integrating relationships for Australia with its 22 trading partners and 126 such relationships for Pakistan with 21 trading partners. Since not all these co-integrating relationships are established, we end up with the estimates of 94 ECVAR models shown in table 3. The results show that the numbers of co-integrating relationships with WPI, CPI and GDP deflator are respectively 41.49%, 25.5% and 32.97% of the number of estimated models. Thus, the possibility of a long-run relationship between nominal exchange rate and relative price at the retail level (CPI) is lower than at the wholesale level (WPI and GDP deflator).

Table 3 presents the summary of the results on Johansen's test for the number of significant characteristic roots in ECVAR model for each bilateral exchange rate and the relative price. Case 2 refers to the specification of ECVAR model wherein the error correcting equation includes an intercept, while VAR model does not have drift (or linear trend in level). In case 3 VAR part of the ECVAR model also includes drift. For both Pakistan and Australia the results are supportive of the PPP proposition. An obvious implication is that the exchange rate policies in the two countries have been closely linked with domestic inflation rate relative to the inflation rate in their trade partners.

The next step of our analysis is to study the error correction dynamics for all those cases where a co-integrating relationship has been established. Since the error correcting equations vary across pairs of country both in terms of specification of the model (that is case 2 or case 3) and the specification of relative price, therefore the results are discussed separately for each country.

1. Pakistan

Details of the adjustment process for the trading partners of Pakistan are given in table 1, the error correction process in exchange rate and relative price between Pakistan and most of its trading partners shows the expected pattern of changes in exchange rate and/or relative price in response to dis-equilibrium forces. The results for Pakistan and Belgium show that, as required for error correction, the coefficient of exchange rate is negative and that of relative price is positive. Furthermore the adjustment process is statically significant both for exchange rate and relative price. This implies that both the exchange rate and price level have been adjusting in the right direction to offset the effects of overshooting in nominal exchange rate beyond the equilibrium level, as defined by the co-integrating relationship. The same pattern is exhibited by the exchange rate and relative price for Canada, Malaysia and USA.

The role of exchange rate remains the same but adjustment due to relative price become insignificant for the countries France, Korea and Sweden. The case of China is different because the relative price changes in wrong direction and plays a significant role. However, the error correcting adjustments in nominal exchange rate are large enough to remove the instability caused by changes in relative price. There are two cases (for Germany and Thailand) that are unacceptable on theoretical grounds. On the whole the error correcting process seems to work well for Pakistan.

Table 1: Rank of the Matrix π for Pakistan

	Relative Price Based on Wholesale Price Index					Relative Price Based on Consumer Price Index					Relative Price Based on GDP Price Deflator				
Trading partner	case 1	case 2	case 3	case 4	case 5	case 1	case 2	case 3	case 4	case 5	case 1	case 2	case 3	case 4	case 5
Australia	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1
Belgium	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
Canada	0	1	1	1	1	0	0	0	1	1	0	1	1	0	1
China	1	1	2	2	2	1	1	2	2	2	1	2	2	2	2
France	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Germany	1	1	0	0	2	1	1	0	0	2	1	1	1	1	2
India	2	1	2	1	2	2	1	2	1	2	2	2	2	2	2
Indonesia	0	1	2	0	0	1	2	2	2	0	0	1	1	0	0
Italy	0	1	1	1	0	0	0	1	0	1	0	0	0	0	1
Japan	1	2	2	1	1	1	2	2	2	2	1	2	2	1	1
Korea	0	1	1	2	1	0	0	0	0	0	0	0	0	1	1
Malaysia	1	2	2	2	2	1	2	1	1	2	1	2	1	1	2
Netherlands	1	2	0	0	0	1	1	1	0	0	1	2	1	0	1
Saudi Arabia	0	1	1	2	2	1	2	1	1	2	1	2	1	1	2
Singapore	0	1	1	0	2	0	2	1	1	1	0	2	1	1	2
Sri Lanka	0	1	1	2	2	0	1	1	2	2	0	1	1	1	2
Sweden	2	1	1	1	1	1	0	2	0	2	0	0	0	0	2
Switzerland	1	2	1	1	2	1	1	0	1	2	1	2	1	1	2
Thailand	1	2	1	2	2	1	1	0	1	2	1	2	1	2	2
U. K.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U. S. A.	0	2	1	1	2	0	0	0	1	2	0	0	0	1	2

Rank equal to zero means that the two variables do not co-integrate.
Rank equal to one means that the two variables are integrated and they do co-integrate.
Rank equal to two means that the two variables are stationary but they do not co-integrate.

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Table 2: Rank of the Matrix π for Australia

	Relative Price Based on Wholesale Price Index					Relative Price Based on Consumer Price Index					Relative Price Based on GDP Price Deflator				
Trading Partner	case 1	case 2	case 3	case 4	case 5	case 1	case 2	case 3	case 4	case 5	case 1	case 2	case 3	case 4	case 5
Belgium	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
Canada	0	0	0	0	2	1	0	0	0	0	2	1	1	1	1
China	0	0	0	1	1	0	1	1	1	1	2	1	1	0	0
France	0	1	1	1	2	0	0	0	0	2	0	0	0	0	0
Germany	0	1	0	0	1	2	0	0	0	0	1	1	2	1	0
India	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0
Indonesia	0	0	0	0	2	0	0	0	1	2	0	0	0	0	2
Italy	0	1	2	0	0	0	0	0	1	2	0	0	0	0	1
Japan	0	1	1	1	2	0	1	0	0	2	0	0	0	0	0
Korea	0	1	2	1	2	0	0	1	1	2	0	1	1	1	2
Malaysia	0	1	2	0	0	0	1	2	0	1	0	0	0	0	0
Netherlands	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0
New Zealand	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2
Philippines	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Saudi Arabia	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1
Singapore	0	0	0	0	1	2	1	1	2	2	2	0	0	1	1
South Africa	0	0	0	1	1	0	0	0	0	2	0	1	1	1	1
Sweden	0	1	2	1	2	0	0	0	0	0	0	0	0	0	0
Switzerland	0	1	1	0	1	2	0	0	0	0	2	0	0	0	0
Thailand	0	1	1	1	1	0	1	2	1	2	1	2	2	1	1
U. K.	0	0	0	1	2	0	0	0	0	1	0	0	0	0	1
U. S. A.	0	0	0	0	2	0	0	0	0	0	0	1	2	1	2

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Table 3: Results for the Significant Characteristic Roots in ECVAR Model

Country	**WPI**				**CPI**				**GDP Deflator**			
	Pakistan		**Australia**		**Pakistan**		**Australia**		**Pakistan**		**Australia**	
	Case		Case		Case		Case		Case		Case	
	2	3	2	3	2	3	2	3	2	3	2	3
Australia	*	*	n	n	*	*	n	n	*	*	n	n
Belgium									*			
Canada	*	*							*	*	*	*
China	*				*		*	*			*	*
France	*	*	*	*								
Germany	*		*		*				*	*	*	
India	*				*						*	*
Indonesia	*								*	*		
Italy	*	*	*			*						
Japan			*	*			*					
Korea	*	*	*					*			*	*
Malaysia			*			*	*			*		
Netherlands					*	*				*		
New Zealand	n	n		*	n	n			n	n		
Pakistan	n	n	n	n	n	n	n	n	n	n	n	n
Philippines	n	n			n	n			n	n		
Saudi Arabia	*	*				*	*			*	*	*
Singapore	*	*				*	*	*		*		
South Africa	n	n			n	n			n	n	*	*
Sri Lanka	*	*	n	n	*	*	n	n	*	*	n	n
Sweden	*	*	*									
Switzerland		*	*	*	*					*		
Thailand		*	*	*	*		*			*		
U. K.												
U. S. A.		*									*	

The trading partners with co-integrating relationship between the nominal exchange rate and relative price are shown by *, while an empty cell indicates the absence of co-integrating relationship. The cases, for which the test is not applied, either because the corresponding countries are not among the selected trade partners or because the same country appears on both sides, are identified by the letter n.

Table 4: Error Correction Parameters for Pakistan

	Wholesale Price Index				**Consumer Price Index**				**GDP Deflator**			
Country	Case 2 π_{ee}	Case 2 π_{er}	Case 3 π_{ee}	Case 3 π_{er}	Case 2 π_{ee}	Case 2 π_{er}	Case 3 π_{ee}	Case 3 π_{er}	Case 2 π_{ee}	Case 2 π_{er}	Case 3 π_{ee}	Case 3 π_{er}
Australia	-0.902*	0.077	-0.863*	0.088	-0.727*	0.066**	-0.689*	0.076*	-0.837*	0.097*	-0.794*	0.105*
Belgium									-0.745*	0.063**		
Canada	-0.686*	0.131**	-0.703*	0.125*					-0.246*	0.212*	-0.368*	0.189*
China	-0.012*	-0.003*			-0.091*	.029**						
France	-0.439*	0.029	-0.403*	0.103								
Germany	0.02	0.151*			0.234	0.161*			0.275*	0.093*	0.058	0.121*
India	-0.438	-0.155*			-0.66*	-0.111						
Indonesia	-0.375*	0.065							-0.297*	0.121*	-0.35*	0.092
Italy	-0.241	0.138*	-0.234	0.141*			-0.459*	0.084				
Korea	-0.509*	0.094	-0.484*	0.115								
Malaysia							-0.917*	0.162*			-0.897*	0.147*
Netherlands					-0.839*	0.015	-0.763*	0.086**			0.679*	0.096*
Saudi Arabia	-0.967*	0.144**	-0.913*	0.223*			-0.772*	0.151			-0.717*	-0.117
Singapore	-0.853*	-0.051	-0.808*	0.023			-0.598*	0.174*			-0.355	0.258*
Sri Lanka	0.083	0.304*	0.082	0.304*	0.07	0.227*	0.068	0.227*	- 0.324**	0.22*	-0.34**	0.217*
Sweden	-0.499*	0.075*	-0.504*	0.073								
Switzerland			-0.601*	0.124*	-0.392*	0.007					-0.34**	0.166*
Thailand			-0.36**	0.197*	0.508*	0.07*					0.059	0.178*
U. S. A.			-0.34**	0.603*								

The parameters π_{ee} and π_{er} denote the error correction parameters for nominal exchange rate and the relative price. The parameters significantly different from zero at 5% and 10% two tailed levels of significance are marked by * and ** respectively.

Table 5: Error Correction Parameters for Australia

	Wholesale Price Index				**Consumer Price Index**				**GDP Deflator**			
	Case 2		Case 3		Case 2		Case 3		Case 2		Case 3	
Country	π_{ee}	π_{er}	π_{ee}	π_{er}	π_{ee}	π_{er}	π_{ee}	π_{er}	π_{ee}	π_{er}	π_{ee}	π_{er}
Canada									-0.736*	0.183*	-0.985*	0.088
China					0.049	0.218*	0.129	0.219*	-0.233**	0.085*	-0.08	0.114*
France	-0.16	0.399*	-0.16	0.397*								
Germany	-0.36	0.116**							-0.01	-0.021*		
India									-0.15	0.268*		
Italy	-0.17	0.233*										
Japan	-0.36	0.256*	-0.5**	0.216*	-0.3	0.107*						
Korea	-0.3	0.107*					-0.768*	-0.204*	0.594*	-0.15*	-0.617*	-0.148*
Malaysia	-0.28	0.221*			-0.07	0.29*						
New Zealand			-1.218*	-0.09								
Saudi Arabia					-0.18	0.289*			-0.13	0.397*	-0.351**	0.392*
Singapore					-0.23	0.316*	-0.29	0.313*				
South Africa									-0.968*	-0.197**	-1.094*	-0.11
Sweden	-0.23	0.214*										
Switzerland	-0.33	0.234*	-0.54	0.201*								
Thailand	-0.78	0.388*	-0.983*	0.333*	-0.813*	0.09						
USA									-0.434*	0.072*		

The parameters π_{ee} and π_{er} denote the error correction parameters for nominal exchange rate and the relative price. The parameters significantly different from zero at 5% and 10% two tailed levels of significance are marked by * and ** respectively.

2. Australia

The results of error correction for Australia are presented in the above table 5. The results show that the nominal exchange rate and relative price adjust in the right direction and plays significant role for most of the trading partners. The error correction process in exchange rate and relative price between Australia and most of its trading partners shows the expected pattern of changes in exchange rate and/or relative price in response to dis-equilibrium forces. The results for USA show that, as required for error correction, the coefficient of exchange rate is negative and that of relative price is positive. This implies that both the exchange rate and price level have been adjusting in the right direction to offset the effects of overshooting in nominal exchange rate beyond the equilibrium level, as defined by the co-integrating relationship. The same pattern is exhibited by the exchange rate and relative price between Australia and Canada.

In case of France, India, Italy, Japan, Malaysia, Sweden, Switzerland and Singapore, however, relative price plays a more active role in offsetting the deviations of nominal exchange rate and/or relative price from the equilibrium path. In case of China the error correcting adjustment in exchange rate, though not in the right direction, is statistically insignificant. However the relative price adjusts in the right direction to offset the deviations in exchange rate and relative price from the equilibrium path.

There is only one wrong case for Australia that is for Germany. It shows that although exchange rate is working in the right direction to remove the dis-equilibrium, but the adjustment parameter is statistically insignificant while relative price is changing in the wrong direction and the corresponding error correcting parameter is also significantly different from zero. In this particular case though the exchange rate and relative price form a co-integrating relationship, there is no evidence of error correction.

IV. Conclusions

The study tests the law of one price for Pakistan and Australia over the period 1972-1997. The analysis is conduced by examining long-run relationship and short-run dynamics between each of the bilateral exchange rates and the relative price levels considering each trading partner of the two countries one by one. Both in Pakistan and Australia primary commodities constitute a substantial part of their exports. The study documents the evidence that is generally supportive of the law.

An interesting outcome of our exercise is that the evidence to accept the purchasing power parity proposition is stronger when it is applied on the wholesale index as compared to the case when it is applied on the consumer price index. In other words, the purchasing power parity is more likely to hold for the wholesale prices than for the retail prices. The model developed here receives indirect but strong support from Chen and Rogoff (2003). They find that the PPP works well for the countries where primary commodities constitute a substantial part of these countries' exports.

The real world is characterized by a number of complications such as differentiated product, taste and wide range of costs, which create considerable problems for economists testing the theory empirically. Since co-integration tests of PPP are unlikely to be robust in the presence of these problems, rejection of the hypothesis of co- integration between exchange rate and prices does not provide very strong support for the rejection of PPP and thus the LOP. However since the evidence is found supporting co- integration between two variables in spite of these problems, the results lend strong support to the proposition that PPP holds as a long-run relationship. The results found here could be considered as adding strong support to the conclusion of Bhatti (2000) and Ahmad (2002), who have found evidence that PPP, holds as a long-run relationship.

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Economic Management and Roots of Inflation in Pakistan

Ayesha Noor and M. Aslam Chaudhary[1]

Abstract

This paper explores and analyzes the main determinants of inflation in Pakistan. A dynamic inflation model was developed to analyze the short run and long run behavior of the inflation. For estimation, the annual data series for the period 1972-2007 was utilized. The results present a positive relationship of price level with money supply, import prices, budget deficit and services sector. The results of Error Correction Model suggest high speed of convergence to equilibrium, if there appears a dis-equilibrating shock. The study also highlights that inflation might be controlled by curtailing dependence on external factors i.e. reducing unnecessary imports. Based on study's results, it is suggested that the main financial cut should be on non-development expenditure, not on development expenditure. Moreover, the policy makers need to consider all factors focused by the study, to have effective control over inflation.

I. Introduction

The recent global and domestic economic crises, as well as financial mismanagement resulted in hyper inflation; of both food and non-food types. The other major problems are balance of payments deficit, rapid increase in petroleum prices, low growth, high unemployment and increasing incidences of poverty; are some of the major challenges for Pakistan[2]. The developing economies like Pakistan, which has a small economy, exports are limited to few major products and also concentrated too few markets, a large import bill and an ever growing population to feed, has badly hit by recent double digit

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[1] *The authors are grateful to anonymous referee for valuable comments. In the light of the comments, the paper was revised which led to substantially improvements in the results and presentation of the paper. The authors are student and professor at Punjab University, Lahore and Forman Christian College (A Chartered University), Lahore, respectively. The paper is based upon M. Phil thesis of Ayesha Noor (2007).*

[2] *Pakistan is suffering from double digit inflation, over 8% unemployment; about 7% of GPD is deficit. Moreover, over 30% of population lives below poverty line. For further details see; Pakistan Economic Survey, 2008-09.*

inflation. The rapidly growing inflation has affected all segments of the society. It has become one of the top most burning issues in Pakistan. On average, GDP deflator was around 10% during 1990's, increased to over 22% during 2008-9. The consumer price index (CPI) increased over 26% during the same period. It is important to investigate and pin point the roots and causes of this issue so that remedial measures could be taken to control it. The expansionary economic policies of government and central bank over the last few years also resulted in aggravating the problem. However, not much effort was made to improve macroeconomic conditions[3]. The performance of the economy has been tempered to the extent that economic growth has fallen below 3 percent and deficit has become a serious bottleneck. Almost half of the day, the entire population and industrial sector are suffering from electric load shedding. It has not only affected livings but it also badly affected industrial production. The increasing inflation had also contributed towards increasing poverty norms.

It is an alarming signal for the economic managers and also draws their attention for immediate tackling this issue. Given the above cited background this study is focused to analyzed roots of inflation. Based upon the sources of inflation its' remedial measures will be proposed. For this purpose a model of inflation has been constructed and empirical data for the years 1972-2007 has been utilized for estimation of the model. The rest of the study is organized as given below. Part II is review of literature and it also provides theoretical background. In part III, econometric model and empirical results are discussed in part IV. Conclusion and policy implications are given in part V.

II. Theoretical Background and Literature Review

The following selective literature review provides an overview of various approaches utilized to analyze inflation, and it also reviews the empirical evidences pertaining to determinants of inflation. The monetarist approach primarily follows, which brought different elements of the Quantity Theory of Money (QTM) together. The Fisher and Cambridge versions of QTM were reformulated while stressing the connection between money and prices. Thereafter a dynamic framework designed to explain price and

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[3] *The GDP growth reached its maximum level of 8.3% unprecedented in the history while investment increased to over 20%. Foreign exchange resources also touched a peak of over 16 billion dollars. Recently the GDP growth fell below 3 percent and poverty increased to over 35% of Population. (For further details see Pakistan Economic Survey (2006-07).*

business fluctuations was developed, which led to highlight interaction among different variables of inflation. The monetarist view reflected that inflation is always and every where a monetary phenomenon. The QTM was criticized because all the versions of the QTM could not adequately explain the great depression of the 1930s. Besides, it ignored variables such as structuralist point of view; particularly inflation theories related to developing countries, which were considered important to explain inflation in developing countries[4]. The phenomenon of inflation in Pakistan received comparatively lesser attention in the literature in earlier period. Even in 1970's, when Pakistan experienced high inflation, only limited number of studies were focused to investigate sources of inflation in Pakistan, i.e. up to the period till 1981.

Generally fiscal policy has remained expansionary in Pakistan and budget was in deficit which did put pressure on the current account deficit, as well as on saving-investment gap. Financing the fiscal deficit through money creation added to inflationary pressure; since it was not utilized for productive purposes. It was mainly utilized to meet current expenditures. The saving schemes of the National Saving Centers were also meant to fill the deficit gap in current expenditures. The schemes were not actually to promote saving but a source to meet non-development expenditures; rather it diverted private savings to meet the need for current expenditures of the government. Such gaps keep on increasing and were as high as up to 7% of GDP[5]. Thus, such a policy continuously contributed towards inflation. The inflationary process was further fueled by expansionary monetary policy[6]. Besides, rising import prices were also an important factor for increasing prices (Chaudhary Aslam M., Munir A. S. Chaudhary & Ijaz, 2006). Besides, depreciation of foreign exchange rate also put upward pressure on price level. Moreover, ever increasing indirect taxes were also considered a source of inflation ((Khan and Qasim, 1996) and Hasan, Ashfaq K. and Muhammad A., (1995). Thus, both monetarist and structuralist variables of inflation need to be explored as sources of inflation in Pakistan.

The structuralist model of inflation appears to be good candidates of inflation in Pakistan. These variables affected real side of the economy such as food prices, wage spiral; import polices expansion in services sector, increase in administered prices of utilities and basic necessities. During the

[4] *For details see: Chaudhary M. A. and Ahmed N. (1996). Also see Khan (2007).*
[5] *For details see: Pakistan Economic Survey, GOP.*
[6] *See: Annual reports, State Bank of Pakistan, Karachi.*

post 1995 period, due to WTO related reforms a large number of tariff and non-tariff trade barriers were removed and opening up of national economy did not improve exports much but it surely increased imports. This outcome increased balance of payment deficit and put further pressure on ever increasing inflation (Chaudhary Aslam, Chowdhry Munir A. S. and Ijaz M., 2006). The mega cross over of goods and services across boundaries in the globalize world of today has introduced new contributory factors of importance to the inflationary phenomenon that it has become a new dimension. This factor has been mentioned merely to emphasize that the conventional monetarist, structuralists theories may not be able to fully explain all the realities of inflationary phenomena in the modern world and particularly in the developing countries.

Hossain (1987 & 1989) developed a monetary and structural model of inflation and concluded that monetary and structural variables of inflation are major source of inflation. The price of traded goods in international market, real income, real money supply, expected inflation and the terms of trade were the major determinants of inflation in Pakistan. Bilquees F., (1988) tested the monetarist and structuralist hypothesis to determine the factors that affect inflationary process in Pakistan. Results of the study strongly suggest the need for simultaneous consideration of both the monetary and structural factors to identify the possible determinants of inflationary process in Pakistan.

Khan and Qasim (1996) observed that Pakistan had experienced a sustained inflation in the double-digit level during the last three years. They made an attempt to provide some explanation regarding the persistent inflation and suggested the need for tightening of fiscal policy. High deficit led to massive borrowing from the banking system and from international sources, which is considered one of the principal sources of accelerating current inflation in Pakistan. Besides, Khan and Schimmelpfenng (2006), Khan H. A. et al. (2007) and Naqvi et al (1994) also found that the expansionary economic policies of the government led to accelerate inflation. This process is further stimulated by expansionary monetary policies of the central bank of Pakistan. Qayyum and Bilquees (2005) analyzed sources of inflation in the long term perspective. This model was based upon quantity theory of money and puts together the long-term determinants of the price level and the short-run changes in current inflation. The results of the study reflected that compared to the simple autoregressive model and the M2 growth augmented model, the

P-star model[7] can be used to obtain the leading indicators of inflation in Pakistan; because it has additional information about the future rate of inflation. Therefore, this paper provides a useful tool to the policy- makers to assess the future movement of inflation in Pakistan. However, in the literature it has also been pointed out that one of the important sources of inflation is import prices, which has been neglected in this study. Khan and Schimmelpfennig (2006) stated that monetary variables are leading indicators for inflation. Broad money growth and private sector credit growth are the key contributing factors towards inflation, which were ignored in the previous studies.

The literature on inflation pertaining to Pakistan indicates that there is hardly any up to date comprehensive study which may have explored all the variables of inflation[8]. Considering all above, all major indicators of inflation; structuralist- monetarist variables and new emerging literature on inflation, a model of inflation has been developed to point out sources of inflation in Pakistan.

III. Theoretical Background and Model Specification

Most of the studies while explaining inflationary process in LDCs have adopted the Harberger (1963). The Harberger Model is essentially an extension of the basic quantity theory framework which relates rate of inflation to rate of growth of money supply, the rate of growth of real income and cost of holding money balances. Following Harberger (1963) and Chaudhary and Ahmed (1996), a model of inflation, based upon Quantity Theory of Money has been developed. The quantity theory of Money holds the relationship:

$$MV = PY \qquad (1)$$

Where P is price level, Y is real income, M is exogenously determined money supply and V is the velocity of money.

Equation (1) may be re-written as:

$$V = PY/M \qquad (2)$$

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[7] *It may be noted that the assumptions of the model are unrealistic and such models are developed for developed economies, which may not be applied to developing countries, until modified as per LDC's characteristics. It is the very reason that there is hardly any study which utilized this model to explain inflation in developing countries.*

[8] *Literature review is based upon over earlier work: see Noor A (2007) and Chaudhary and Ahmed (1986).*

Where V-1 the inverse of velocity , is the ratio of real income held as real balances and it depends upon the level of real income Y and the expected cost of holding real balance C.

Assuming a conventional demand for money function:

$$V\text{-}1 = Y\alpha\, C\text{-}\beta \qquad (3)$$

From (2) and (3) we obtain equation 4 as[9].

$$M/PY = Y\alpha\, C\text{-}\beta \qquad (4)$$

By cross multiplication & solving for M we can obtain:

$$M = PY\ \ Y\,\alpha\, C\text{-}\beta \qquad \text{or}$$
$$M = PY\,(1+\alpha)\, C\text{-}\beta \qquad (5)$$

The monetarist model predicts the existence of a stable demand function for real money balances. Their level is postulated to be a function of the level of real income. In addition the monetarist model postulates that money supply is exogenous and it can be controlled by the monetary authority. By assumption the demand for money tends to equate the supply of money. Therefore, fundamental symmetry between the demand for money function and the Harberger equation of inflation relates to the central assumption of exogenous money supply.

Taking natural log on both sides of equation (5), we get:

$$Ln(M) = Ln(P)+(1+\alpha)Ln(Y)\text{-}\beta Ln(C) \qquad (6)$$

Rearranging equation (6) for Ln(P);

$$Ln(P) = Ln(M) - (1+\alpha)Ln(Y)+\beta\, Ln(C) \qquad (7)$$

Equation 7 may be tested empirically, which may be called model one.

This simple transformation permits us to express the price level as a function of quantity of money, level of real income and cost of holding real money balances. The interest rate represents cost of holding real money balances. As we know structural variable are not a part of this model, which are important source of inflation for developing countries. Some structural elements are incorporated to assess the role of structural rigidities in determining inflation. The foreign sector, services sector and the fiscal sector

[9] *Chaudhary M. Aslam and Ahmad N. (1996) and Ahmed N. (1994). Also see Sunkel (1958).*

rigidities variables need to be tested as explanatory variables for inflation. Besides, external prices or prices of imported goods are also considered as contributing factors to accelerate inflation. Pakistan has an open economy but a small country meaning thereby that it is a price taker of imported goods since it has virtually no influence on the price determining factors of imported goods; specially those important to the manufacturing sector and energy prices[10]. Another most frequently used indicator is the unit value index of import prices in domestic currency terms. Import price index represents a composite index incorporating the combined effect of external forces magnified by the internal structure. The unit value of imports is postulated to be positively related to inflation. Exchange rate is another determinant of inflation which shows that due to depreciation/devaluation. The payment for imported items increases i.e. exports become cheaper for rest of the world but imports become expensive. Besides, budget deficit is also a determinant of inflation, and it is argued that increase in budget deficit positively affects the inflation.

Incorporating all above theoretical discussion, the equation (7) may be written as model 2, for empirical investigation.

Model: 2

$$\text{Ln } P_t = \beta_o + \beta_1 \ln Y_t + \beta_2 \ln M_t + \beta_3 \ln R_t + \beta_4 \ln BD_t + \beta_5 \ln ER_t + \beta_6 \ln MP_t + e_t$$

Where:

P_t = Inflation Rate, Y_t = Real gross domestic product,

R_t = Interest Rate, M_t = Money Supply (M_2), BD_t = Budget Deficit,

ER_t = Exchange Rate and MP_t = Import Prices

The growth in the services sector which primarily employees human resource as input, if not accompanied by a parallel growth in the output, it would lead to demand pull inflation. For this very reason, we have used only the value of services sector (YS) in the model instead of using the entire GDP.

The model 2 can be rewritten as model 3, as given below.

Model: 3

$$\text{Ln } P_t = \beta_o + \beta_1 \ln YS_t + \beta_2 \ln M_t + \beta_3 \ln R_t + \beta_4 \ln BD_t + \beta_5 \ln ER_t + \beta_6 \ln MP_t + e_t$$

[10] *See: Romer (1993).*

The above cited dynamic inflation models can be empirically estimated to identify sources of inflation in Pakistan.

IV. Empirical Results

Different procedures are applied to analyze the preliminary analysis of the data series. First, we plot the log form data series against time, including inflation series, money supply, and output of the services sector, import prices, exchange rate, budget deficit and interest rate, respectively. Augmented Dickey Fuller Test (ADF) is utilized to check the stationarity of the data series. The results are reported in table 1. The ADF Test is performed by estimating the following equation with and without trend variables (t):

$$\Delta Y_t = \alpha + \beta_t + \rho Y_{t-1} + \lambda_i \quad \Sigma_{i+1}\text{-N}\ \Delta Y_{t-i} + u_t$$

After estimating the equation, we test the hypothesis as to whether $\rho = 0$. In ADF Test, lagged difference is included to remove possible serial correlation in the error terms. This test confirms the order of integration of individual series. The ADF test statistic corresponds to the t-value of parameter ρ for the individual series. To test the hypothesis that $\rho=0$, calculated t-values are compared with tabulated value, as given in Mackinnon (1991).

The data for inflation rate (LNP), money supply (LM2), output of the services sector (LYS), import prices (LMP), exchange rate (LX), budget deficit (LBD) and interest rate (LR) are used in log form. The ADF test is applied on the log form with an intercept, a linear trend and with out linear trend; cases are included in the ADF test equation of these variables to allow for trend stationary. The level form for inflation rate (LNP), money supply (LM2), output of the services sector (LYS), import prices (LMP), exchange rate (LX), budget deficit (LBD) and interest rate (LR) are not stationary. The results show that all variables are Integrated of order one i.e. I (1). The first difference seems to remove the stochastic trends from the data. In case of each series an appropriate lag length is used so that serial correlation is removed from error term, which is confirmed by the LM test of serial correlation. The results presented in table 1 shows that null hypothesis of unit root (ρ=0) can not be rejected for any variable in the level form. However, the null hypothesis of unit root is rejected for all variables in the first differenced form at 5% level. Thus, our test results show that all variables are integrated of order I (1).

The results obtained in this part provide grounds to move to the co-integration method to estimate the inflation function. The estimation of the inflation

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function by applying co-integration technique is the subject matter of the next section.

Table-1: Augmented Dickey-Fuller Test Results for Unit Root

Level Form			First Difference Form			Results
Variable On Level	**With Trend** ADF-Stats	**Without Trend** ADF-Stats	**Variables on First Difference**	**With Trend** ADF-Stats	**Without Trend** ADF-Stats	
LnP	-2.4831	-2.8807	Δ LnP	-5.9722*	-5.9147*	I(1)
LM2	-2.3138	-0.4647	Δ LM2	-4.4092*	-4.4696*	I(1)
LYS	-2.1999	-1.1791	Δ LYS	-4.32425*	-4.4011*	I(1)
LMP	-3.3643	-0.2799	Δ LMP	-4.2596*	-4.5582*	I(1)
LX	-2.4768	0.5251	Δ LX	-4.5833*	-4.7398*	I(1)
LBD	-3.0598	-2.1612	Δ LBD	-6.6803*	-4.5323*	I(1)
LR	-0.2930	-1.5713	Δ LR	-3.8501*	-3.7413*	I(1)

Note: ** Denote significant at five percent. 2. I (1) indicates unit root in level form and stationary after first difference.*

1. The Long-run Inflation Function: A Co-integration Analysis

The main purpose of the study is to analyze the determinants of inflation in Pakistan. Main explanatory variables tested are; money supply, import prices, output of the services sector, exchange rate, budget deficit and interest rate etc., which are included in the model based upon theoretical grounds. The empirical analysis shows that the proxy for interest rate that is call money rate and exchange rate has been found to be insignificant, and thus we drop these regressors to arrive at our preferred specification.

Before running cointegration test we need to specify the lag structure. This is important because a lag structure which is too high may over parameterize and, therefore, reduce the power of cointegration test. However if the lag structure is too short it may not produce the residuals which are white noise. In order to investigate the optimal lag structure Schwarz Bayesian

Criterion (SBC) as suggested by Enders (1995, p.88) and Davidson (1998), for various lags were performed. The appropriate lag length of VAR is one. In order to determine the number of significant cointegrating vectors, we use Johansen's (1988) likelihood ratio test that is based on Maximum Eigen Value and Trace Test Statistic. The results from Johansen cointegrated test (both the Eigen value and the Trace test) are presented in table 2. All variables included for the test have the same order of integration.

Table-2: Johansen Cointegration Test (Maximum Eigen Value Test).

Null Hypothesis	Alternative Hypothesis	Test Statistic	5% critical values
r = 0	r = 1	17.75248*	17.20
r = 1	r =2	11.41882	14.36
r = 2	r = 3	4.212246	11.37
r = 3	r = 4	3.000633	08.11
r = 4	r = 5	0.758025	04.13

Trace Test

Null Hypothesis	Alternative Hypothesis	Test statistic	5% critical values
r = 0	r ≥ 1	85.52309*	68.52
r = 1	r ≥2	44.64647	47.21
r = 2	r ≥ 3	18.3537	29.68
r = 3	r ≥ 4	8.65464	15.00
r = 4	r ≥ 5	1.745422	3.76

Note: 1 * Indicates significant at the 5% level. The variables are: P, LM2, LMP, LYS & BD.

The likelihood ratio (LR) test, both λ-max and λ-trace support the hypothesis that there is one cointegrating vector at 5% level of significance in each case. The empirical results suggest that there exist only one unique long run relationship among inflation and its determinants. The long-run inflation function presented here is obtained by normalizing the estimated cointegrated vector on inflation (Ln P). Significance of the variables confirms their validity in the model and suggests that there is a long run stable relationship between inflation and exogenous variables. The results of estimated long-run inflation function are reported in the following equation.

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$$\text{LnP}_t = 1.4247 + 0.3836^*(\text{LM2}) + 0.3520^*(\text{LYs}) + 0.0584^*(\text{LMP}) + 0.3400^*(\text{LBD})$$

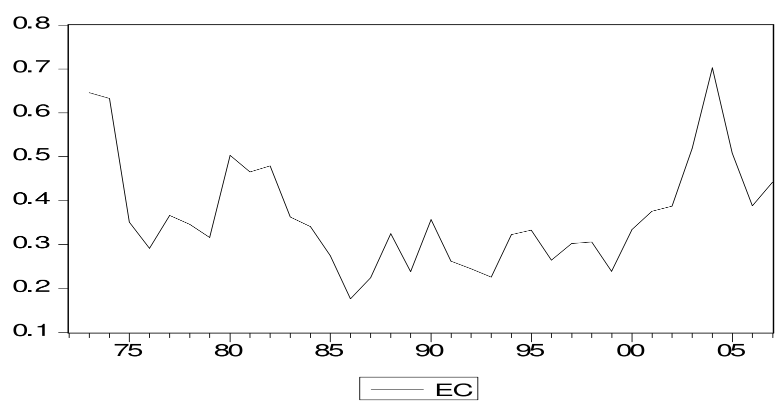
(S.E)	(0.11242)	(0.2169)	(0.0259)	(0.08913)
[T-Value]	[3.412]	[1.623]	[2.255]	[3.815]

The estimated coefficients of LM2, LMP, LYS and LBD have expected signs and are significant at acceptable level. The estimated equation indicates that inflation is mainly determined by the money supply, import prices and budget deficits. The impact of the increase in the output of the services sector is not significant. The estimated elasticities are 0.38, 0.35, 0.06 and 0.34, respectively.

2. The Short-Run Dynamic Model of Inflation: The Error Correction Approach

After establishing the cointegration relationship an error correction model (ECM) is established to determine the short-run dynamics of the regression model. Following Hendry's approach known as "general to specific" we include different lags from top to low of explanatory variables and error term EC (-1). The error term (EC) consists of the residual from the long-run inflation function. The graph of the error series is presented in the following graph.

Figure 1: EC



The Error term is well behaved, it is stationary at level form confirmed by ADF and the white noise is ensured by LM test. The following error correction model (ECM) is established to determine the short-run dynamics of the regression model.

$$\Delta LnP = \beta 0 + \beta 1\Delta LnP\ (-1) + \beta 2\Delta LM2 + \beta 3\Delta LM2\ (-1) + \beta 4\Delta LMP + \beta 5\Delta LMP\ (-1) + \beta 6\Delta LYS + \beta 7\Delta LYSP\ (-1) + \beta 8LBD + \beta 9LBD\ (-1) + \lambda EC(-1) + Et$$

After estimating this model, we gradually eliminate insignificant variables. The results suggested that out of these regressors, only eight variables established short-term relationship with inflation, significantly. All others insignificant variables are dropped from the ECM. This provides that in short-run LnP(-1), LM2(-1), LMP, LMP(-1), LYS, LYS(-1), LBD(-1) and EC(-1) have emerged significant variables, while others do not prove their existence in the short-run. The following ECM is found to be the most appropriate and fits the data well.

$$\Delta LnP = \beta 0 + \beta 1\Delta LnP\ (-1) + \beta 3\Delta LM2\ (-1) + \beta 4\Delta LMP + \beta 5\Delta LMP\ (-1) + \beta 6\Delta LYS + B7\Delta LYS\ (-1) + \beta 8\Delta LBD\ (-1) + \lambda EC(-1) + Et$$

All the variables are in first difference. The results of final estimated parsimonious dynamic error correction model are given in below.

ΔLnP =	0.0193 -	0.257*ΔLnP(-1) +	0.131*ΔLM2(-1) +	0.104*ΔLMP +	
S.E.	(0.189)	(0.123)	(0.074)	(0.028)	
T-value	[1.015]	[-2.092]	[1.762]	[3.662]	

	0.068*ΔLMP(-1) +	0.846*ΔLYS +	0.416*ΔLYS(-1) -
S.E.	(0.033)	(0.197)	(0.216)
T-value	[2.068]	[4.288]	1.921]

	0.114* ΔLBD -	0.36* EC(-1)
S.E	(0.021)	(0.064)
T-value	[-5.36]	[-5.635]

R- bar-square = 0.737 F (9, 33) = 09.4156

The error correction coefficient estimated at (-0.36) with (t = -5.634) enters into short run dynamic equation at highly significant with theoretically correct sign[11]. The estimated coefficient of EC indicates that approximately 36 percent of the dis-equilibrium in determination of inflation is corrected

[11] *The validity of the estimated model is tested by using standard diagnostic tests; for autocorrelation etc. The definition of variables is presented in appendix I.*

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immediately, i.e. in the next year. It suggests a high speed of convergence to equilibrium if there appears a disequilibrating shock.

In estimated dynamic error correction model, the coefficient of lagged changes in inflation is negative and significant, which shows, the changes in previous period inflation negatively affect on short-term changes in inflation. It may reflect that inflation phenomena cannot be treated as the result of present period decision only. It also reflects there is some sort of cyclical movement in inflationary situation. The coefficient of lagged changes in money supply is also positive and significant. The fluctuations in the previous period in money supply positively affect the current changes in inflation. The results of the analysis suggested that the impact of changes of the money supply on the determination of the general price level works through transmission lags. Thus, inflation increases due to the expansion of money supply.

The coefficients of import prices and one period lagged import prices are significant with positive sign showing that under the global village scenario Pakistan is also affected by world inflation. It may reflect the situation that when price of imported goods like oil, machinery, equipment and other raw materials increases, consequently these prices raises the cost of production and as a result it contribute to increase domestic prices upward. These ascendances may be rapid or gradual depending upon the nature of commodities and their use.

Another finding of the analysis is that the current and previous period's changes in output of the services sector also affect the level of inflation positively in short term just like long run. This may be due to a reason that the increase in volume of the services sectors increases the aggregate demand of goods and services, where as there is not much increase in the output or addition in the commodity producing sector. So as a result of rise in aggregate demand, due to market forces price level also moves upward and the inflationary situation is generated. The estimated coefficient of the budget deficit is negative in short run; however, over the long run it has positive impact on inflation. It may be due to foreign assistance, which provides relief in short run and in long run it enhance the inflationary pressure on the economy.

V. Conclusions and Policy Implications

This study is an attempt to identify and analyze the main determinants of inflation. For this purpose an inflation model was developed and estimated for Pakistan for the period 1972-2007, using annual data series. Based upon the empirical evidences, it was also aimed to provide remedial measures to control the inflation. Considering theoretical developments and empirical evidence, econometric model was developed containing the wide range of determinants of inflation including Services Sector, Money Supply, Budget Deficit, Interest Rate, Exchange Rate and Import prices. A dynamic inflation function was specified to analyze the short run and the long run behavior of the determinants of inflation in Pakistan. To estimate the model we applied the co-integration technique. As a first step, we have employed well known Augmented Dickey Fuller (ADF) tests to each of the series of data and determined the order of integration. After confirming the order of integration of each variable, Johanson (1988), Likelihood Ratio (LR) tests, such as maximum Eigen-value test and Trace statistic were used to determine a long run equilibrium relationship among the variables. Finally Error Correction Model (ECM) was estimated to study the short run dynamics of inflation behavior.

The cointegration analysis indicates that long run relationship exists between dependent and explanatory variables. It was found that there is a positive relationship between money supply and the price level and both move in the same direction. The analysis also indicates that a positive long run relationship exists between inflation rate and import prices which imply that import prices are an important determinant of inflation in Pakistan. Increase in import prices creates significant affects on general price level in the same direction. One of the main causes of inflation is an increase in price level due to external factors i.e. imported inflation. The coefficient of the services sector is positive, although not significant in long run. The empirical evidences also indicate that budget deficit is positively related to inflation. Increase in budget deficit implies that government expenditures exceed its income/ revenues; major proportion of it consist off non-development expenditures which increases aggregate demand and therefore results in an increase in general price level.

The results of error correction model indicated that the coefficients are significant with expected sign. It suggests a high speed of convergence to equilibrium if there appears a disequilibrating shock. Moreover, error

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correction model reflects that the inflation phenomenon cannot be treated to be the sole effect of decisions taken in present situation. The lagged impact of variables continues to contribute to inflation. The analysis also reflected that money supply component of the monetary policy should be framed considering both its immediate and long term effects on the economy to have a more effective control on the general price level in the country.

The study also highlights that one main source of inflation is an increase in import prices. We may control inflation by curtailing our dependence on external factors i.e. reducing unnecessary imports. The empirical results also showed that as income of the services sectors increases, demand for goods also increases that brings an upward movement in general price level which is a general phenomenon in developing countries. This may reflect the case of demand pull inflation in Pakistan and can be controlled by increasing output level in the economy, removing inefficiencies and reducing current expenditures. Thus, the policy makers should consider this aspect carefully and proper attention should be given on increasing output in the commodity producing sector. Besides, Pakistan is continuously suffering from budget deficit which is not good for the economy; therefore, it must be kept under control to reduce inflation. It is suggested that the main financial cut should be on non development expenditure, not on development expenditure. However, in Pakistan there is always cut on development expenditures. As a result the squeezing development expenditures and ever rapidly increasing current expenditures lead to inflationary pressure. The policy makers need to consider all the above cites factors to have effective control over inflation.

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Appendix-I: The Definition of the Variables and Data Sources

The variables used in this study include: Inflation Rate (P), Output of the services sector (YS), Money Supply (M), Interest Rate (R), Budget Deficit (BD), Exchange Rate (ER), and Import Prices (MP). The study covers the period from1972 to 2007.

Inflation Rate (P): Inflation rate is derived from combined consumer price index (general). The CPI data is taken from various issues of the annual report of State Bank of Pakistan.

Output of the Services Sector (YS): It is derived from gross output of services sector of the economy at market prices i.e., the total flow of services which are created/ provided during the period. It is collected from different annual issues of the Pakistan Economic Survey, Ministry of Finance, Government of Pakistan.

Money Supply (M): It is the broad money (M2), which is used for the money supply. This data series is taken from various issues of the annual report of State Bank of Pakistan.

Interest Rate (R): It is a call money rate, which is a proxy variable for interest rate. This data series is also taken from various issues of the annual report of State Bank of Pakistan

Budget Deficit (BD): Budget deficit is used in nominal series; it is collected from different annual issues of the Pakistan Economic Survey, Ministry of Finance, Government of Pakistan.

Exchange Rate (ER): Nominal Exchange rate is used for the exchange rate variable and this data series is taken from various issues of the annual report of State Bank of Pakistan.

Import Prices (MP): Unit Value of import is used to capture the impact of import prices. This data series is also taken from various issues of the annual report of State Bank of Pakistan.

Appendix-II: Diagnostic Test.

The validity of the estimated model is tested using the standard diagnostic tests. The residual passed the diagnostic test of no autocorrelation [$\chi2(1) = 0.489$], no hetroskedasticity [$\chi2(4) = 12.013$], normally distributed [$\chi2(2) = 1.86$], no ARCH [$\chi2(1) = 0.659$] at the 5 percent level of significance. The parameter stability of any estimated function has been the more crucial test, this stability in the model confirmed by the cusum and cusum of squares.

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An Economic Study of Slow Growth of Crops in Pakistan: A Case of Pulses Production in Punjab

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Abstract

This study attempts to explain the growth trends and supply response behaviour of pulse crops in Punjab. The study examines the trends in area, production and productivity of gram, mung, mash, masoor and matar pulses, and also estimates the growth rates of area, production and productivity of different pulses. Moreover, we examine the response of supply of different pulses to changes in; relative price of the crop, relative yield of the crop, own price of the crop, own yield of the crop, gross irrigated area to gross cropped area, rainfall during the critical periods, price risk and finally, yield risk. Nerlovian partial adjustment lagged model has been used to test the factors influencing the farmers supply allocation. The results reveal that the slow growth in most of the pulses production can be mainly attributed to stagnation and decline in area.

I. Introduction

Technological change has given a face lift to the agricultural sector. It was well established by now that the change was confined to better endowed provinces and also to superior cereals (rice and wheat). These crops competed with the other crops for resources and were awarded better part of them, be it research or infrastructure. In result, this will hampered the growth of other crops to a considerable extent. Grain legumes[2] are one such crop group neglected and hence termed as slow growth crops.

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[2] *Grain legumes area all grain pulses, ground nuts and soybeans.*

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Pulses, a main component of grain legumes, not only play a role of inexpensive protein supplier in the absence of relatively expensive animal proteins (meat, fish and egg) for majority of the population, but also carry out a much important task of soil fertility maintenance by supplying nitrogen to the soil through symbiosis in a cropping sequence. According to one estimate, pulses leave between 30 to 40 kg. of nitrogen per hectare in soil[3]. In spite of this, pulses are assuming a secondary status in the farmer's decision calculus.

Due to fluctuations/stagnation, the per capita availability of pulses has gone down to 0.0187 Kgs. per day in 2005-06, being 0.0207 Kgs. per day in 1975-76. This decline is due to an increase in population, on one hand, and a decline in the production of pulses on the other, which is largely affected by a decrease in the area under pulse crops. Other reasons for this decline are heavy dependence on rainfall, lack of new technology, poverty of farmers and an absence of infrastructural support. Nevertheless, the poor performance of pulses at the macro level is the result of farmer's decisions and actions vis-à-vis this crop. The farmers' approach to pulses crops in turn is conditioned by their characteristics, which are (1) low value status, (2) adaptation to poor habitat and resource base, and (3) production and consumption by the poorer members of society. The increasing gap between the demand and supply of pulses has led to sharp rises in their prices, which in turn are causing much hardship to the common man. This increasing gap is causing a serious concern to planners and policy makers in Pakistan.

All the provinces of Pakistan produce different kinds of pulses in varying quantities. Punjab is a major pulse growing province contributing 83 percent of area and 77 percent of production in Pakistan's total area and production of pulses during the year 2005-06. The main pulses produced are mung, mash, masoor and matar (lentils). Gram is also primarily used as a pulse. Share of different kinds of Punjab pulses in total pulses are presented in table 1. Area and production share of gram and mung shows an increasing trend while that of mash and masoor a fluctuating and decreasing trend between 1975-76 and 2005-06. The area share of matar crop was decreased where as its share in production increased over the time. As far as share of different kinds of Punjab pulses in their respective total pulses are concerned,

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[3] *For detail see; Oppen (1980)*

gram and mung share in area and production has increased between 1975-76 and 2005-06 (table 2 and figure 1).

Table 1: Share of Different Kinds of Pulses Produced in Punjab in Total Pulses

(Percent)

Years	Gram		Mung		Mash		Masoor		Matar	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
1975-76	51.45	54.55	3.10	2.81	3.34	3.29	3.78	2.68	2.61	1.99
1980-81	51.26	49.18	3.49	4.22	4.89	5.96	4.60	4.67	2.88	3.67
1985-86	56.57	55.25	5.12	4.17	5.46	5.36	3.08	3.16	2.66	2.62
1990-91	56.14	55.05	7.73	6.19	4.69	4.38	3.00	2.57	2.49	2.99
1995-96	56.07	58.51	7.35	8.40	3.27	2.68	2.74	2.47	2.25	2.58
2000-01	58.68	53.88	14.93	14.92	3.04	3.54	2.12	2.88	1.78	2.93
2005-06	64.09	55.85	13.48	14.86	2.16	1.98	1.47	1.47	1.37	2.15

Source: Agricultural Statistics of Pakistan (different issues), Government of Pakistan, Islamabad.

Table 2: Share of Different Kinds of Pulses Produced in Punjab Pulses in Their Respective Total

(Percent)

Years	Gram		Mung		Mash		Masoor		Matar	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
1975-76	71.11	71.08	68.05	68.96	84.59	86.58	76.68	74.20	25.65	23.60
1980-81	76.18	71.27	65.22	64.78	89.88	85.84	79.23	77.29	21.85	23.68
1985-86	79.46	75.09	71.40	60.04	89.19	87.50	77.87	80.51	27.39	30.78
1990-91	79.11	75.89	83.97	80.18	91.15	87.23	72.87	69.12	26.86	30.97
1995-96	80.13	79.09	87.44	85.21	89.86	86.62	67.02	66.76	25.35	30.27
2000-01	86.20	84.33	90.56	88.71	88.21	85.60	61.17	66.54	23.08	29.79
2005-06	87.48	79.77	90.79	89.38	87.86	82.42	61.06	56.42	21.37	28.05

Source: Agricultural Statistics of Pakistan (different issues), Government of Pakistan, Islamabad.

The share of gram in area and production has increased from 71.11 and 71.08 in 1975-76 to 87.48 and 79.77 percent respectively in 2005-06. Similarly the area and production share of mung increased from 68.05 and 68.96 percent in 1975-76 to 90.79 and 89.38 percent respectively in 2005-06. Masoor area and production share declined between 1975-76 and 2005-06. Mash area share increased while that of its production shares it decreased. Reverse is true for matar. There is thus an urgent need to review the performance of pulses crop developing a strategy to boost up their production across Pakistan in general and for Punjab in particular. In Pakistan except Ahmad (1983) and Syed (1973) no such study is available relating to this topic.

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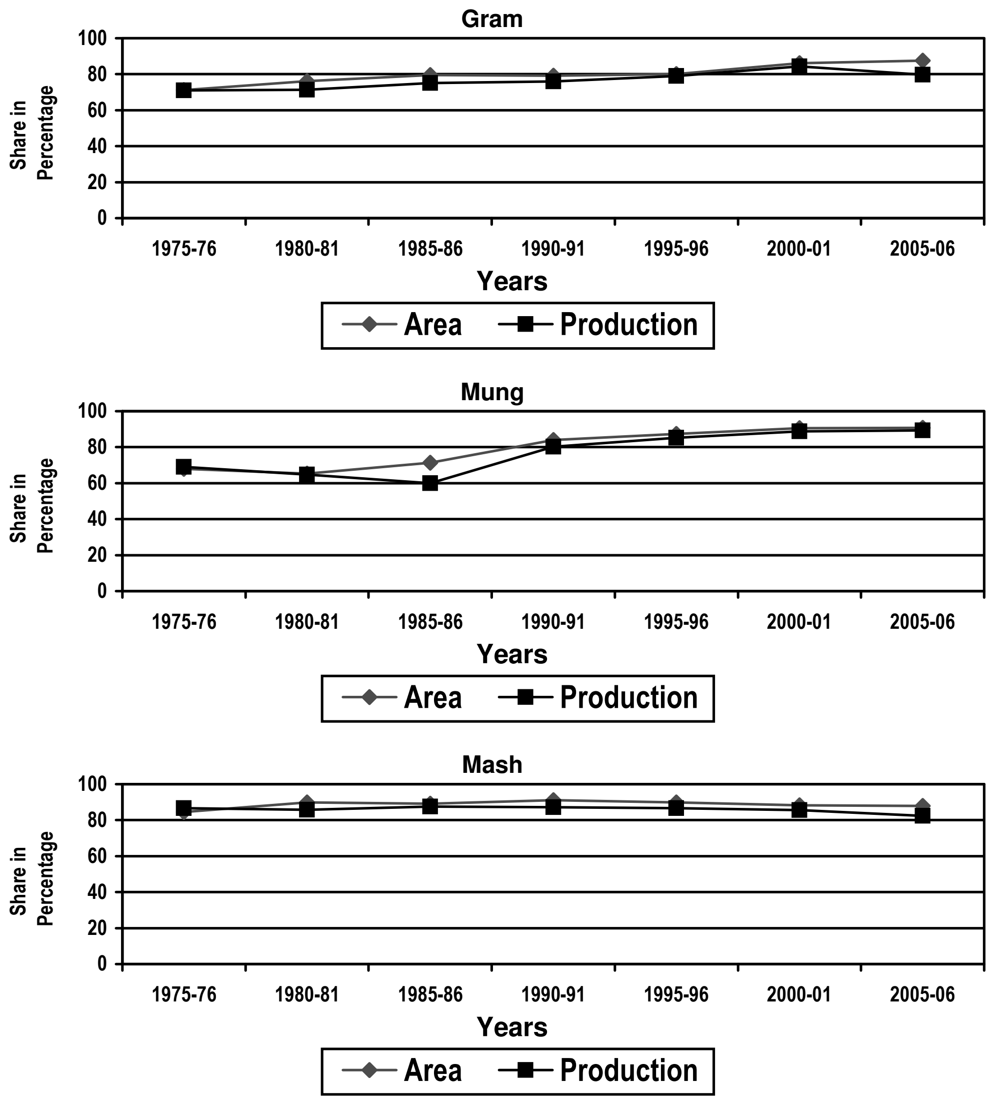
Figure 1: Share of Different Kinds of Punjab Pulses in their Respective Total Pulses



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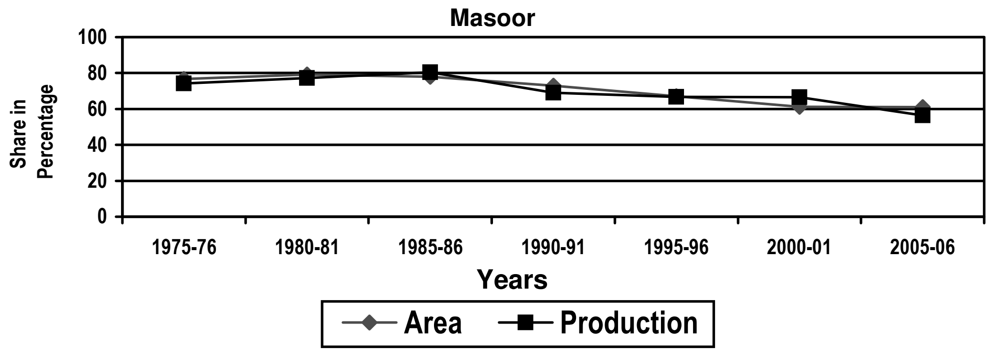

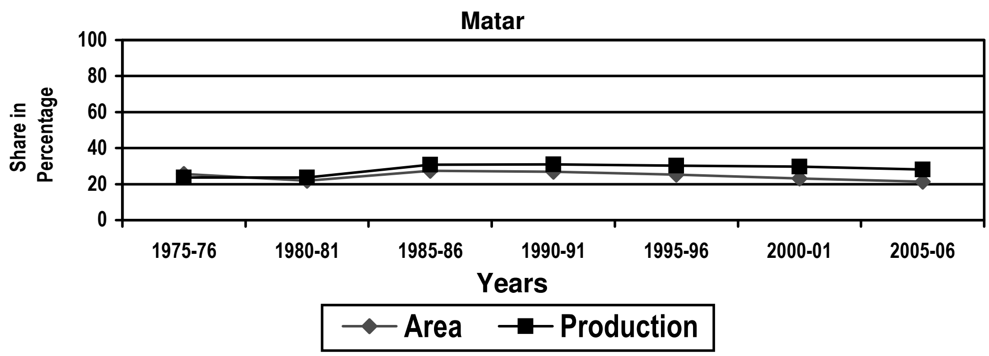

The specific objectives of this study are:

i) to analyze the trends in area, production and productivity of gram, mung, mash, masoor and matar pulses in Punjab

ii) to estimate growth rates of area, production and productivity of different pulses in Punjab

iii) to examine the response of supply of different pulses to changes in (1) relative price of the crop, (2) relative yield of the crop, (3) own price of the crop, (4) own yield of the crop, (5) gross irrigated area to gross cropped area, (6) rainfall during the critical periods, (7) coefficient of variations of the prices, and (8) coefficient of variations of the yield.

The rest of the paper is organized as follow; section II deals with data and study area, methodology of the study is discussed in section III, section IV is specified for results and discussion and last section V presents conclusion and policy implications.

II. The Data and Study Area

Five most important pulse crops (gram (chana), green gram (mung), black gram (mash), lentil (masoor) and field pea (matar)) produced in Punjab province are included in this study. The five crops together account for 83 percent of all pulses produced in Punjab. The study covers the time period starting from 1975-76 to 2005-06 for which data on crops acreage, prices, yields, rainfall, irrigation, etc., were collected from Agricultural Statistics of Pakistan, government of Pakistan. The study is confined to the province of Punjab in Pakistan.

III. Methodology of the study

1. Growth Rates

In order to examine the trend growth rates of pulse area, production and productivity, linear, exponential and semi-exponential functions were fitted. Semi log exponential form was finally selected considering the highest value of coefficient of determination (R^2). The form of semi log exponential function is as under:

$$\ln Y = a + bt \quad (1)$$

Where:

Y = area/production/productivity of major pulse crops
A = constant
B = expresses the rate of change and when multiplied by 100 gives the percentage growth rate in area, production and productivity of major pulse crops
T = time period in years (1, 2, ……, n)

2. Acreage Response

In agriculture farmers decision plays an important role, but the transformation process involved in it, depending as it does on a number of uncontrolled natural inputs and human and animal labor, is more unpredictable than in industry. Farmers also face a number of constraints while making production decisions in response to changes in price and non-price factors. The farmer allocates his land to different crops, depending upon his expected revenues from it. Assuming that input costs are either the same or more uniformly distributed overtime for different crops, the expected revenue depends upon the expected price. It is seldom that farmer become able to make hundred percent adjustments while responding to various economic factors, or adjust instantaneously. In agriculture which is subject to weather uncertainties, or which is undergoing changes in production technology as in the case of some developing countries, such constraints become still more severe. Under such conditions the adjustment lagged model is considered appropriate for measuring farmers' response behaviour. Following Nerlove's seminal work[4] on the dynamics of supply response, this model has been widely used by a number of researchers[5] in agricultural supply response studies.

The long run supply A^*_t is assumed in the Nerlovian framework, to be related to P_t (the price) in a simple linear manner:

$$A^*_t = a + bP_{t-1} + U_t \qquad (2)$$

variations in A^*_t is connected by variations in observed or actual supply by assuming the following relationship between the actual and long run desired level of supply.

$$A_t - A_{t-1} = \beta\,(A^*_t - A_{t-1}) \qquad (3)$$

The current supply then is:

$$A_t = At_{-1} + \beta\,(A^*_t - A_{t-1}) \qquad (4)$$

β is the coefficient of adjustment, which accounts for forces which cause the difference between the short-run and long-run supply – price elasticities. $A_t - A_{t-1}$ is actual change and $A^*_t - A_{t-1}$ is desired or long-run change. The second equation is a behavioural relationship, stating that the desired acreage under the crop studied depends upon the relative farm prices in the preceding year. The fourth equation states that the actual planted area of crop in period *t* is equal to the previous actual planted area plus a proportion of the difference between desired planted area in period *t* and actual planted area in period t-1. This hypothesis implies that farmers cannot fully adjust their actual planted area to the desired area in response to changes in the explanatory variables

[4] *See Marc Nerlove (1958, may 1958).*
[5] *Krishna (1963), Cummings (1975), Parikh (1972), Sangwan (1985), Khan and Iqbal (1982), Savadatti and Narappanavar (1997), Ahmad (1983), Rahman (1986), Sarup, Pandey and Verma (1983), Deshpande and Chandrashekar (1982), and Singh (1979).*

due to constraints such as fixity of assets, physical land conditions, habitual production patterns of farmers, etc. 'β' is, therefore, an indication of how fast the farmers are adjusting themselves to their expectations. The value of 'β' close to zero would mean that the farmer are slowly adjusting to the changing prices, yield etc. The value of 'β' close to one would mean that the farmers are adjusting quickly to the changing levels of prices, yield, etc. And the adjustment is instantaneously and perfect when β=1. In the real world however, the value of 'β' lies between 0 and 1.

The relationship between equations (2) and (3) give the reduced form, which eliminates the unobserved variable (A^*_t) by an observe variable (A_t).

$$A_t = A + BP_{t-1} + CA_{t-1} + V_t \qquad (5)$$

Where:

$A = a\beta$, $B = b\beta$, $C = (1\text{-}B)$ and $V_t = \beta U_t$

Equation (5) provides a simple version of partial adjustment model and the parameters of which can be estimated by the least-squares method if the original U_t's are serially uncorrelated (Gujarati, 2003). The advantage of partial adjustment model is that if the estimated residuals V_t of equation (5) are found to be serially uncorrelated, then U_t also become serially uncorrelated because $V_t = \beta U_t$. In result, the estimated coefficients are not likely to be affected by serial correlation. Therefore, OLS estimation of the partial adjustment model will yield consistent estimates although the estimates tend to be biased (in finite or small samples)[6]. Although A_{t-1} depends on U_{t-1} and all the previous disturbance terms, it is not related to the current error term U_t. Therefore as long a U_t is serially independent A_{t-1} will also be independent or at least uncorrelated with U_t, thereby satisfying an important assumption of OLS, namely, non-correlation between the explanatory variable(s) and the stochastic disturbance term. The reduced form would remain basically the same even if we include more independent variables than the ones included in equation (5).

Besides accounting for the 'lags' that occur in farmer's adjustment behaviour, the model postulated above also helps in the estimation of both the short-run and long-run supply elasticities.

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[6] *For details see, Ram D. Singh (1979).*

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Using the adjustment lagged model[7] as the basic frame of analysis, the response relationships in the study were estimated with the help of the following equation.

$$\text{Log } A_t = \log a + b_1 \log RLP_{t-1} + b_2 \log RLY_{t-1} + b_3 \log POC_{t-1} + b_4 \log YOC_{t-1} + b_5 \log AI_t + b_6 \log R_t + b_7 \log CV_p + b_8 \log CV_y + b_9 \log A_{t-1} + U_t \quad (6)$$

Where:

A_t	=	area under the pulse crop at time t (in hectares)
RLP_{t-1}	=	relative price of pulse crop to the competing crop at time t-1 (ratio)
RLY_{t-1}	=	relative yield of pulse crop to the competing crop at time t-1 (ratio)
POC_{t-1}	=	own price of the crop at time t-1 (Rs./40 Kgs.)
YOC_{t-1}	=	Own yield of the crop at time t-1 (per hectare)
AI_t	=	gross irrigated area to gross cropped area in rabi/khareef season (percentage)
R_t	=	rainfall during the critical periods (mid August to mid October for gram, May 15 to July 31 for mung and mash, September-November for masoor and matar)
CV_p	=	Coefficient of variations of the prices of the crop concerned for the years t-1, t-2 and t-3, used as a measure of price risk (in Rs.)
CV_y	=	Coefficient of variations of the yields of crop concerned for the years t-1, t-2 and t-3 used as a measure of yield risk (in Kg.)
A_{t-1}	=	area under the pulse crop at time t-1 (in hectares)
A^*_t	=	desired or long-run area under crop in year t
V_t	=	error term in year t
β	=	coefficient of adjustment

The log form of the function was chosen because of convenience. It provided direct estimates of supply elasticities besides saving in degrees of freedom. Incorporation of variables such as yield, irrigation and risks rather than concentrating only on the price factor as has generally been done in the past, is considered important to our understanding of the puzzle of shrinking acreage under pulses despite a rise in their prices.

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[7] *For proof see, J. Johnston (1984).*

The study hypothesized that the price factor does not play a significant role in influencing the supply of pulses. This one is due to differences in inter-crop technological innovations, whether cost-reducing, or yield-increasing, or both, would change the input-output coefficients for different crops. These changes might be such that the price variable per se is related to the background. It is a fact that competing crops wheat and rice have, in recent years, witnessed technological break-through of much greater significance than any other crop. The resultant differentials in inter-crop yields have changed the pattern of relative profitability among the various crops. Therefore, it is plausible to expect that the price factor would play a weak role in influencing the acreage under pulses.

The hypothesis pertaining to irrigation was that it would cause a reduction in the area under pulses. With expansion in areas under assured irrigation, it is expected that the farmers will substitute crops like rice and wheat for pulses crops. Water requirements of the former crops (rice and wheat), especially the HYVs, are much greater than most of pulse crops. For the same reason rainfall was expected to have a similar effect on intercrop shifts in acreages.

Risks arising from both the price and the yield variations were expected to act as deterrent factors on acreages under pulses. The farmers were hypothesized to be risk averters. Because of the presence of lagged values of the dependent variable on the right hand side of equation (6), the Cochrane-Orcutt technique will be employed in the ordinary Least Square (OLS) regression procedure, in order to account for possible autocorrelation problems. The long-run price elasticities will be calculated by using the short-run price elasticities.

$$\text{Long-run price elasticity of acreage} = \frac{\text{Short-run price elasticity}}{\text{Coefficient of adjustment}}$$

Whether this model suffers from the auto-correlation problem or not, can not be tested by using the DW d-statistic, since the model includes a lagged-dependant variable (lagged acreage in this case) in the regression equation, the DW d-statistic is likely to have reduced power and biased toward the value 2, [Durbin (1970) and Nerlove (1958)]. For such an equation, Durbin has

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suggested an alternative test statistic known as Lag range Multiplier Test or the h-statistic[8], defined as:

$$h = \left[1 - \frac{1}{2}d\right]\sqrt{\frac{n}{1 - n\bar{v}(\bar{b}_9)}} \qquad (7)$$

Where:

$\bar{v}(\bar{b}_9)$	=	least square estimate of the variance of b_9.
d	=	usual DW d-statistic
n	=	number of observations

Under the null hypothesis of no autocorrelation, *h* is asymptotically normal with zero mean and unit variance. The test statistic can also be used to test the hypothesis of no serial correlation against first-order auto-correlation, even if the set of regressors in an equation contains higher order lags of the dependent variable. However, if $\bar{v}(\bar{b}_9) > \frac{1}{n}$, then h cannot be computed from this equation [Green (1990)]. "Inter-correlation of variables is not necessarily a problem unless it is high relative to the overall degree of multiple correlation" (Klein 1962). If there are strong interrelationships among the independent variables, it becomes difficult to disentangle their separate effects on the dependent variable. If there are more than two explanatory variables, it is not sufficient to look at simple correlations. Thus the term "inter-correlations" should be interpreted as multiple correlation of each explanatory variable with the other explanatory variables. Thus, by the Klein's rule, multi-collinearity would be regarded as a problem only if $R_y^2 < R_i^2$, where $R_y^2 = R_y^2.\times_1\times_2......\times_k$ and $R_i^2 = R_{\times i}^2.\,other\times' s$. A categorical test of inter-correlations among the explanatory variables was conducted that ensures the best linear unbiased (asymptotic) estimates (BLUE)[9].

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[8] *The serial correlation is tested through 'h' statistics and the use of classical linear regression model (CLRM) incorporating the assumption that U_t is distributed identically and independently with zero mean and constant variance (Jai Krishna and Rao, 1967, Sawant, 1981).*

[9] *For detail see, appendix table 1.*

IV. Results and Discussion

Before discussing the results, we have analyzed the figures for the period of 1975-2006 to show the trends in area, production and productivity[10]. Data shows that the area under gram though increased at the end of the study period but recorded a fluctuating trend between 1975-76 to 2005-06. Production and productivity of the crop in the majority of the years recorded a declining trend. The highest area, production and productivity of gram were recorded in the year 2004-05. The area and production of the crop Mung shows an increasing trend during the study period. The highest area and production was recorded in the year 2002-03 and 2003-04. Productivity of the crop though increased but at a decreasing rate. The area, production and productivity of the crop Mash recorded a decreasing trend during the study period. The area, production and productivity which were 49400 hectares, 25800 tonnes, and 526 kg/hectares respectively in 1975-76 decreased to 30400 hectares, 13600 tonnes and 447 Kg/hectares in 2005-06.The area and production of the crop Masoor recorded decreasing trend, while that of productivity an increasing trend. The area under the crop Matar increased up to 1990-91, after that it recorded a decreasing trend. The production of the crop in majority of the years recorded an increasing trend. Productivity of the crop recorded an increasing trend which implies that farmers were utilizing farm inputs efficiently while the climatic conditions were also suitable for the crop.

1. Growth Rates in Crop Output

The results presented in table 4 show that the production of gram increased at a rate of 1.57 percent per annum, mung at 6.92 percent per annum and matar at 0.31 percent per annum. The increase in the production growth of gram was due to increase, both in area growth and productivity growth, but the productivity growth contributed more as compared to the area growth. It means that farmers were utilizing farm inputs efficiently and timely. The increase in mung production growth was mainly due to increase in its area growth rather than productivity growth. This implies that the mung producing farmers are also utilizing the area of mash. In case of matar, the increase in its production growth was mainly due to increase in its productivity growth. This might be due to favourable climatic conditions and utilization of better farm

[10] *For detail see, appendix table 2.*

technologies. Mash and Masoor recorded negative growth rates in area and production as against positive growth in Masoor productivity. It means that wheat farmers are increasing their area by taking it out from Matar and Masoor. The major conclusion of this table is that in most of the pulse crops the growth in production was mostly due to growth in productivity rather than area.

Table 4: Compound Growth Rates for Area, Production and Productivity of Major Pulse Crops in Punjab (1975-76 to 2005-06)

(Percent per annum)

Crops	Area	Production	Productivity
Gram	0.538 (2.937)*	1.574 (2.451)**	1.036 (1.810)***
Mung	6.680 (22.05)*	6.925 (26.11)*	0.256 (1.247)
Mash	-1.184 (2.386)**	-1.327 (2.935)*	-0.145 (0.745)
Masoor	-2.953 (7.563)*	-0.989 (2.421)**	1.959 (6.996)*
Matar	-2.550 (9.045)*	0.314 (2.197)**	2.336 (23.30)*

*, **, *** *Significant level at 1, 5 and 10 percent, respectively. Figures in parentheses are 't' values.*

2. Acreage Response Analysis

The results of the estimated regression coefficients of supply response functions for major pulse crops in Punjab are presented in table 5.

(i) Relative and Own Price

Except gram, the impact of relative price variable has been either too weak or even negative in some cases (masoor and matar). The impact of the economic incentives on gram and mash acreage is found to be significant, as is evident from the significant positive impact of relative price on gram and own price on mash acreage. For gram, the variable is significant at 1 percent and for mash it is significant at 10 percent. For mung, masoor and matar the relative price variable is insignificant. The positive sign of the variable suggests that additional income from the crop in the preceding year has generally led to higher investment in the acreage of gram and mash in the

Punjab province. This in a way suggests that for a producer, growing competing crops mainly for family consumption is of little importance. The farmer would generally like to meet his subsistence requirement out of his own farm to feel secure. An excess production over subsistence requirements in a good year of the competing crop is generally saved for future consumption rather than sold out. This means that market price has a potential to increase gram production. The negative relative price coefficients of masoor and matar though statistically insignificant show illogical economic relationships. The results have to be interpreted in the background of the fact that the continuously declining acreage has been accompanied for Masoor and matar crop under study with rising prices of these crops over the last decade. It is also a fact that the price factor has almost been over-swamped by the non-price factors such as technological changes in competing crops (wheat, gram) in influencing shifts in inter-crop acreages. Ram D. Singh (1979), Kusum Chopra (1982), R.S. Deshpande and H. Chandrashekar (1982), and Bashir Ahmad (1983) observed a mixed pattern of positive and negative responses of price variable for different pulse crop.

(ii). Relative Yield

The impact of relative yield variable is positive and significant only for gram crop at 5 percent level. However for masoor and matar it is negative and statistically significant at 5 percent level. The negative impact of the yield should be considered in the context of spread of HYVs of seeds of the competing crop, wheat.

(iii). Irrigated Area and Rainfall

The ratio of gross irrigated area to gross cropped area is positive and significant for mung and matar crop at 5 percent level of significance. Mung and matar are mostly irrigated crops. It means that with expansion in irrigation facilities the farmers of mung and matar crop will increase the crop area. That's why the rainfall variable of these two crops is statistically non-significant. The rainfall variable has no effect on these crops acreage. Gram, mash and masoor are mostly un-irrigated crops. Therefore the irrigation variables of these crops are statistically non-significant. There effects are captured in rainfall variable. The variable is statistically significant at 5 percent level. Increase in rainfall will increase gram, mash and masoor crop area.

(iv). Risk Variables

Changes in acreage allocation and cropping pattern involved risk. Generally, such changes give rise to two major sources of risk, one arising from fluctuations in prices and the other pulses variation in yield. How farmers have varied acreage under crops in response to these risks is important to know. On one hand, fluctuation in prices reflects conditions of demand and supply including uncertainties and imperfections in marketing systems. Variability in yield, on the other hand, is caused by weather conditions, as is the case for most of the crops in Punjab or by changes in production technologies. The relative incidence of these risks may differ among individual crops. The variability due to price and yield gives expected negative sign for all the crops. The price risk coefficient is significant at 5 percent level only for mung crop. For all other crops though the coefficients are negative but statistically insignificant. The significant negative sign of price risk variable for mung crop indicates that mung growing farmers appear to be risk-lovers by putting less acreage under the crop. The variability due to yield upholds our expectation (negative sign) for all the crops. The coefficient is significant at 5 percent level for gram, masoor and matar crop, while for mung, it is significant at 10 percent level. It means that farmers of these crops keep in mind the weather conditions and changes in production technology.

(v). Lagged Crop Acreage

Lagged gram and Mung acreage has positive and significant impact, indicating slow adjustment response on the part of farmers. For mash and matar crop, lagged acreage has negative and significant influence, indicating an over adjustment of planted acreage to the desired acreage.

(vi). Adjustment Behaviour and Short-Run and Long-Run Relative Price Elasticities

As our model is based upon Nerlove's adjustment hypothesis, it will be interesting to know how far the estimated equations for actually planted area support this argument. The rapidity with which the farmers adjust the acreage under a crop in response to movements in factors discussed above, is

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Table 5: Estimated Regression Coefficients of Supply Response Functions for Major Pulse Crop in Punjab

Crop	Competing Crop	Intercept	Regression Coefficients									Coefficient of Adjustment	Multiple Coefficient of Determination	Durbin 'h' Statistics	Relative Price	
			Relative Price in t-1	Relative Yield in t-1	Own Crop Price in t-1	Own Crop Yield in t-1	Gross Irrigated Area/Gross Cropped Area in *t*	Rainfall in *t*	Price Risk	Yield Risk	Crop Acreage in t-1				Short-Run Elasticity	Long-Run Elasticity
Gram	Wheat	4.313	0.603 (3.416)*	0.274 (2.341)**	–	–	-0.132 (1.022)	0.631 (2.561)**	-0.156 (1.316)	-0.268 (2.183)**	0.597 (2.332)**	0.403	0.95	0.322 (NSC)	+0.603*	+1.496*
Mung	Rice	3.756	0.162 (1.432)	–	–	–	0.432 (2.211)**	0.131 (1.211)	-0.213 (2.193)**	-0.196 (1.983)**	0.286 (1.962)***	0.714	0.86	0.421 (NSC)	+0.162	+0.226
Mash	None	2.113	–	–	0.189 (1.871)***	0.132 (1.392)	-0.129 (1.041)	0.549 (2.312)**	–	–	-0.259 (2.316)**	1.259	0.81	-0.219 (NSC)	+0.189[a]	+0.150[b]
Masoor	Wheat	3.516	-0.039 (1.325)	-0.267 (2.416)**	–	–	0.123 (1.361)	0.411 (2.210)**	-0.129 (1.512)	-0.213 (2.314)**	0.139 (1.421)	0.860	0.92	0.513 (NSC)	-0.039	-0.045
Matar	Wheat	4.619	-0.126 (1.395)	-0.321 (2.519)**	–	–	0.325 (2.516)*	-0.116 (1.161)	-0.131 (1.456)	-0.219 (2.410)*	-0.316 (2.411)**	1.316	0.89	0.362 (NSC)	-0.123	-0.095

Figures in parentheses are 't' values. *, ** and *** shows level of significance at 1, 5 and 10 percent, respectively.
a Short-run own price elasticity.
b Long-run own price elasticity.
NSC No serial correlation.

seen from the numerical values of the coefficient of adjustment (β). For the entire pulse crop studied (gram, mung, mash, masoor and matar), lagged dependent variable (A_{t-1}) for gram and mung entered positively and for mash and matar, it entered negatively. The adjustment coefficient of mash and matar is outside the assumed range of zero to one. Hence mash and matarindicates over-adjustment to the desired change in acreage. The adjustment coefficient of gram (0.403) and mung (0.714) are within the assumed range of zero to one. This low rate of adjustment coefficient points out that gram and mung farmers in Punjab are significantly influenced by institutional and technological constraints while expanding or contracting area under these crops and that price inducement operated slowly and gradually.

The long-run elasticity with respect to relative price is higher than short-run elasticity for gram crop. It means that gram growers of Punjab have more time to adjust their acreage under the crop in the long-run than in the short-run. For mash crop the case is just the opposite.

V. Conclusions and Policy Implications

The present study has been directed to find out the trend growth rates and identifying economic and non-economic factors responsible for variations in major pulses acreage in Punjab. The growth trend and supply response analysis shows that an increase in the production growth of gram was due to increase, both in area growth and productivity growth, but productivity growth contributed more as compared to area growth. The increase in Mung production growth was mainly due to increase in its area growth, rather than productivity growth. It means that Mung growing farmers are also utilizing the area of mash crop. The increase in matar production growth was only due to increase in its productivity growth. Utilization of better farm technologies and favourable climatic conditions are the major factors in its growth. Masoor pulse recorded negative growth rates in area and production as against positive growth in its productivity. It means that wheat growing farmers are increasing their crop area at the expense of matar and Masoor area. In most of the pulse crops, the growth in production was mostly due to growth in its productivity rather than area.

The Acreage Response Analysis reveals that in the process of making the area decisions for gram, Mung, Mash, Masoor and matar cultivation, all the variables i.e. relative and own price, relative yield, irrigated area, rainfall, risk variables and lagged acreage are not equally important for all the pulse crops. The impact of the economic incentives on gram and mash acreage is found to be significant, as evident from the significant positive impact of relative price on gram and own price on mash acreage. For Mung, Masoor and matar, the relative price variable is insignificant. For Masoor and matar it is also negative. The positive sign of the variable suggests that additional income from the crop in the preceding year has generally led to highest investment in the acreage of gram and mash. The farmer would generally like to meet his subsistence requirements out of his own farm to feel secure. An excess production over subsistence requirements in a good year of the competing crop is generally saved for future consumption rather than selling it. This means that market price has potential to increase gram and mash production. The negative relative price coefficient of Masoor and matar though statistically insignificant show illogical economic relationships. The reason is that the price factor has been almost over-swamped by the non-price factors such as technological changes in competing crops (wheat, gram) in influencing shifts in inter-crop acreages.

The impact of relative yield variable is positive only for gram crop, while for Masoor and matar pulse it is negative. The negative impact of the yield should be considered in the context of spread of HYVs of seeds of competing crop, which is wheat. The ratio of gross irrigated area to gross cropped area is positive and significant for Mung and matar crop. It means that with expansion in irrigation facilities the farmers of Mung and matar crop have increased the crop area. The rainfall variable is positive for gram, mash and Masoor crop. It means that increase in rainfall increases the area of these crops.

The slow growth in most of the pulse crops production (especially matar and masoor) can be attributed mainly to stagnation and decline in area. Therefore, production of these crops can be increased through the widespread use of improved seeds, introduction of higher yielding varieties, adoption of improved methods of cultivation and better control of pests and diseases. In order to increase matar and masoor production, the government needs to provide HYVs at minimum prices to farmers. The price and risk factors will need to be considered, though appropriate measures in order to provide the necessary incentives to the producers for maintaining pulse acreage at desired levels. An appropriate policy will therefore require that the farmers should be assured of a good but stable return from the crop and necessary infrastructural facilities for ushering in modern agriculture with new agricultural practices. An indirect policy implication is that, since dairy and poultry products may provide good substitutes to counter nutritional deficiencies arising from the scarcity of pulses, efforts are needed to be directed towards the promotion of enterprises like dairy and livestock in agriculture.

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Appendix Table – 1
Test of Multicollinearity of the Explanatory Variables
(By Klein's Rule) Used in the Regression Analysis of Pulses

Pulses		**Partial R^2 (Each Explanatory Variable as a Dependent Variable)**								
	Total R^2	**Relative Price**	**Relative Yield**	**Own Crop Price**	**Own Crop Yield**	**Irrigated Area**	**Rain fall**	**Price Risk**	**Yield Risk**	**Crop Acreage**
Gram	0.95	>0.52	>0.35	–	–	>0.49	>0.46	>0.61	>0.38	>0.56
Mung	0.86	>0.39	>0.42	–	–	>0.52	>0.51	>0.35	>0.42	>0.51
Mash	0.81	>0.46	>0.51	>0.43	>0.38	>0.41	>0.44	>0.46	>0.45	>0.52
Masoor	0.92	>0.43	>0.61	–	–	>0.52	>0.48	>0.49	>0.51	>0.43
Matar	0.89	>0.47	>0.39	–	–	>0.46	>0.43	>0.51	>0.46	>0.45

Each explanatory variable used as dependent variable, in turn, on other explanatory variables (according to the model type of the Table Equation). If the partial R^2 is greater (>) than the total R^2, then there is harmful multicollinearity of the variable on the other variables conversely, (i.e. R^2 total >R^2 partial), the collinearity problem is not serious (see Maddala, 19767). The associated symbol of the explanatory variables, i.e. > indicates that the total R^2 is greater than the partial R^2. All the variables are in natural logarithms.6

Appendix Table – 2
Area, Production and Productivity of Different Kinds of Pulses (Gram, Mung and Mash) in Punjab during 1975-76 to 2005-06

Years	Gram			Mung			Mash		
	Area (Hectares)	Production (Tonnes)	Productivity (Kg/hectare)	Area (Hectares)	Production (Tonnes)	Productivity (Kg/hectare)	Area (Hectares)	Production (Tonnes)	Productivity (Kg/hectare)
1975-76	759700	427500	563	45800	22000	480	49400	25800	526
1976-77	785700	465000	892	40300	18900	468	40300	20900	519
1977-78	817100	449700	550	42500	20400	480	43100	22600	523
1978-79	934400	398800	427	39800	17600	443	40900	19800	485
1979-80	870500	213100	245	46600	21900	467	57000	28300	497
1980-81	642100	240100	374	43700	20600	472	61300	29100	474
1981-82	700100	159300	228	40800	19500	477	59100	28000	474
1982-83	679800	353400	520	49700	24600	495	63900	30000	471
1983-84	711400	380600	535	60100	26000	433	60900	33000	542
1984-85	795900	379600	477	63800	28200	457	73900	41000	555
1985-86	821100	440200	536	74400	33200	446	79200	42700	539
1986-87	859800	430500	501	81300	37700	464	69100	33200	480
1987-88	642400	246600	384	71900	32400	451	68600	31400	458
1988-89	763400	294100	385	76400	31400	411	72000	28000	389
1989-90	815600	396700	486	119500	45200	378	79300	35300	445
1990-91	863500	403000	466	118900	45300	381	72100	32100	445
1991-92	792800	390900	493	104800	40000	382	73000	32400	444
1992-93	820000	227000	276	122500	48400	395	70000	25700	366
1993-94	844700	286400	339	147400	57600	391	58700	24500	417
1994-95	846100	425400	502	153800	67400	438	48200	22700	472
1995-96	896600	537500	599	174100	77200	443	52300	24600	471
1996-97	906400	472600	521	172500	78700	456	52300	25100	480
1997-98	908300	646200	711	166300	72000	433	43400	22100	509
1998-99	887600	577700	651	170700	75100	440	39700	21200	533
1999-2000	809200	465500	575	179600	82000	457	37900	20000	529
2000-01	780100	334800	429	198500	92700	467	40400	22000	545
2001-02	816000	304200	373	215800	102000	472	49300	23800	484
2002-03	860000	611500	711	237300	125700	530	50800	25800	509
2003-04	854400	524000	613	231000	126800	549	43600	21300	488
2004-05	956400	760600	795	206600	118300	573	33200	15500	467
2005-06	900100	382500	425	189300	101800	538	30400	13600	447

Source: Agricultural Statistics of Pakistan (different issues), Government of Pakistan, Islamabad.
Note: Table 2 continues to next page.

Appendix Table – 2 (continued)
Area, Production and Productivity of Different Kinds of Pulses (Masoor and Matar) in Punjab during 1975-76 to 2005-06

Years	Masoor			Matar		
	Area (Hectares)	Production (Tonnes)	Productivity (Kg/hectare)	Area (Hectares)	Production (Tonnes)	Productivity (Kg/hectare)
1975-76	55900	21000	378	38600	15600	406
1976-77	62500	23200	371	47800	19900	417
1977-78	74600	26900	360	44700	19100	427
1978-79	88400	30900	350	51300	21800	425
1979-80	68600	28500	415	39000	18700	479
1980-81	57600	2800	396	36100	17900	496
1981-82	53500	22100	413	43100	21400	496
1982-83	60700	20100	331	38900	19400	497
1983-84	35500	15500	436	44400	23100	520
1984-85	36300	20000	553	43000	21400	497
1985-86	44700	25200	565	38600	20900	542
1986-87	66200	25100	378	41300	22100	535
1987-88	60000	23200	388	36600	20300	554
1988-89	58400	24600	421	39900	22000	552
1989-90	50900	21800	428	39400	22900	580
1990-91	46200	18800	407	38300	21900	572
1991-92	40300	17100	424	37300	21500	576
1992-93	45100	19000	421	37600	21600	576
1993-94	32200	15500	480	34500	21400	619
1994-95	41900	21300	508	32500	21000	646
1995-96	43900	22700	517	36000	23700	659
1996-97	47800	23600	495	36000	23200	645
1997-98	43400	25600	590	33000	25400	772
1998-99	37000	26400	713	30500	24300	797
1999-2000	34900	25500	731	30900	24600	794
2000-01	28200	17900	635	23700	18200	768
2001-02	28800	18300	637	26500	20800	786
2002-03	34200	21600	630	21700	17400	801
2003-04	35300	22000	623	19800	15500	783
2004-05	28000	17200	614	17900	13900	777
2005-06	20700	10100	488	19300	14700	762

Source: Agricultural Statistics of Pakistan (different issues), Government of Pakistan, Islamabad.

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Dynamic Impact of Remittances on Economic Growth: A Case Study of Pakistan

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Abstract

Remittances are one of the largest sources of financial inflow for developing countries. In recent years, they have gained significant importance for their role in balance of payments. In this study, we examine the dynamic impact of workers' remittances on economic growth of Pakistan. For this purpose, we used a Keynesian type simultaneous econometric model with a dynamic perspective. The macroeconomic key variables are investigated with an eventual purpose of estimating their respective contributions to economic growth. It is found that the highest induced growth rate by remittances to output growth took place in the early 1980s particularly, 1982-83 which corresponds to the high inflow of remittances from the Middle East. Our analysis shows that, although the workers' remittances mostly used for private consumption and partially for imports but it contributed to growth positively through the multiplier effects.

I. Introduction

As part of the spread of globalization and industrialization, the world has experienced a concomitant growth in the flow of labour across countries. With better working conditions and opportunities for higher wages in developed countries, these labour flows have been skewed towards the developed countries. It is now estimated that about 191 million people live and work outside the country of their birth (DESA, 2006). In 2007, recorded remittances sent to home by migrants reached $265 billion, more than double the level reached in 2002 (Ratha, et al., 2008). Migrants send home remittances to support their relatives and/or friends. These flows tend to be more stable than other external flows and may even be counter cyclical to the

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receiving economy. As migrants tend to send more during hard times to help families and friends, remittances tend to go up when the receiving economy suffers from an economic recession (Orozco, 2003 & World Bank, 2005). In contrast, many other types of private capital flows move pro-cyclically, rising in booms and falling in recessions (Ratha, 2003).

Remittances go to the households and individuals, whereas other external sources of funds such as foreign aid go to public agencies in recipient countries. Hence the effectiveness of remittances is not hampered by the corruption of government officials (Kapur, 2005). Remittances improve a nation's creditworthiness and can thereby enhance access to international capital markets to finance infrastructure and other development projects (Ratha, 2005; Yang, 2004; Woodruff and Zenteno, 2004). Remittances also generate foreign exchange, essential for making up any shortfall in the balance of payments, for promoting investment, and in dealing with the problems of poverty. At the household-level, remittances can be used to smooth consumption levels and provide capital both for investment and old-age security (Schrieder & Knerr, 2000).

Empirically, Cattaneo (2005) has found that remittances are spent typically on investments that will promote growth-investments in both physical and human capital, the latter focused on health and education. Remittances have also been found to produce a significant impact on macro variables like consumption, investment and imports [Talafha, (1985); Glytsos, (2002); Glytsos, (2005)] and economic growth [Nishat & Bilgrami, (1991); Glytsos, (2002); Glytsos, (2005); Natalia, et al., (2006); Bichaka, (2008)]. Similarly, remittances have been found helpful in reducing poverty [Quartey, (2005); Rukshana & Nadeem, (2008)] by directly increasing incomes, allowing smoothing consumption and easing capital constraints on the poor (Jongwanich, 2007). The rest of the paper is organized as follows. Part II presents trends of worker remittances to Pakistan. Part III deals with theoretical framework, model specification and data description. Empirical results are presented in section IV and finally, section V provides conclusions.

II. Trends of Worker Remittances to Pakistan

Remittances have played a vital role in the economy of Pakistan. The flow of remittances have helped to stabilize Pakistan's financial sector (Shahbaz, et al., 2008) and have remained one of the most important components of the balance of payments since the late 1970's (Nishat & Bilgrami, 1991). The countries from which workers' remittances are received include: the United States, United Kingdom, Saudi Arabia, United Arab Emirates, GCC countries (including Bahrain, Kuwait, Qatar and Oman), the European Union, Australia, Canada and Japan. In 1972-73 remittances were $136 million. The oil shocks of 1973 dramatically increased the import bill and thus worsened the balance of payments problem. However, the emergence of the Middle East market and remittances they provided contributed significantly to an improvement in the balance of trade (Afzal, 2008). During the 1975-82 time period, Pakistan experienced large scale labour migration to countries experiencing rapid economic growth, particularly to the Middle East. Before their migration about half of these workers were engaged in low paid jobs (Arif, 1995). On arrival, these workers frequently transferred a major share of their income back to their families. Estimates suggest that migrants remit about 75% of their earnings to their country of origin (Gilani et al., 1981 & Addleton, 1992). Those who receive these remittances use roughly 62 percent for consumption, with 35 percent either saved or invested. A large part of the money received was used to pay for consumer goods, with lesser amounts used to finance house construction, to pay-off debts, and to purchase land. During 1980s, remittances from the Middle East provided strong social and economic benefit for many of Pakistan's households.

With the Gulf Crisis and the return of immigrants from Iraq and Kuwait, the boom of the 1980's reversed in the beginning of 1990s. By 1990-91, the inflow of remittances had declined to US $1848 million of which the proportion from the Middle East decline from 86% in 1983-84 to 67%. Although in 1996-97 the share provided by the Middle East temporarily increased to 73%, total remittances fell overall to Rs.1409 million (Government of Pakistan,1998). Remittances once again experienced a setback in 1998-99 and 1999-00. This was mainly due to the imposition of sanctions and the seizing of foreign accounts caused by nuclear explosions (Asghar & Ashfaq, 2004) which in turn caused a declined in the confidence on the banking system by many Pakistani migrants (Haq, 2001). The decline in remittance inflows during the 1990s was a major contributor in increasing poverty in Pakistan (Siddiqui & Kamal, 2002).

Since September 11, 2001 remittances have increased sharply and now reach over $4 billion annually. In 2005–06 (the year of the earthquake) official remittances reached $4.6 billion, an increase of 10% over the previous year (State Bank of Pakistan, 2006). In 2006-07, Pakistan received $5.493 billion as remittances (Govt. of Pakistan, 2007) and in 2007-08 the remittances were estimated at record $6.5 billion (SBP, 2008). On the other hand, other external flows such as foreign direct investment and portfolio investment from abroad have decreased due to the volatile political situation and shortage of energy; remittances continue to be a significant and increasing source of revenue.

III. Theoretical Framework, Model Specification and Data Description

The main objective of this study is to isolate empirically the short and long-run impacts of remittances on key economic variables and economic growth in Pakistan. We used Glytsos (2002) model to test these effects. This involved constructing a linear simultaneous equation macro econometric model in order to determine the effects of workers' remittances on private consumption, investment, imports and the level of income. From this system the estimated effects of remittances and their time distribution on the key macroeconomic variables that affect economic growth could be found.

The model consists of three behavioral equations, consumption, investment and import function, and one equilibrium condition. The structure of the model is

$$Cp_t = \theta_0 + \theta_1 Y_t + \theta_2 Cp_{t-1} \qquad (1)$$

$$Inv_t = \lambda_0 + \lambda_1 Y_t + \lambda_2 K_{t-1} \qquad (2)$$

$$M_t = \delta_0 + \delta_1 Y_t + \delta_2 M_{t-1} \qquad (3)$$

$$Y_t = Cp_t + Cg_t + Inv_t + (Ex_t - M_t) + WR_t \qquad (4)$$

Where, Cp = Private Consumption Expenditures, Y = Gross Domestic Product + Workers' remittances, Inv = Gross Fixed Capital Formation (Public and Private) plus Changes in Stocks, M = Imports of Goods and Non-factor Services, E_x = Exports of Goods and Non-factor Services, K = Cumulative Gross Domestic Investment (used as a proxy for capital stocks), C_g = Government Consumption Expenditures and WR = Workers' remittances

Equation (1) is a dynamic consumption equation that incorporates partial adjustment. In this equation, the level of income, which also includes remittances, and lagged value of private final consumption expenditures are explanatory variables. The coefficients of these explanatory variables are expected to be positive. Equation (2) assumes that investment is a positive function of income (*Y*) and a negative function of a lagged capital stock (K_{t-1}) allowing some time for investment to adjust to the stock[2]. Equation (3) is the imports equation. In this equation the level of income and lag of imports used as explanatory variables. Both are likely to have positive impact on import. Equation (4) is income identity which includes workers' remittances as exogenous variable.

1. Impact Multiplier

After making necessary substitution in equations (1), (2) and (3)[3] we derive the following reduced form equations for consumption, investment and import:

$$ZCp_t = \theta_0(1-\lambda_1+\delta_1)+\theta_1(\lambda_0-\delta_0)+\theta_1 Cg_t+\theta_1 Ex_t+\theta_1 WR_t+ \\ \theta_2(1-\lambda_1+\delta_1)Cp_{t-1}+\theta_1\lambda_2 K_{t-1}-\theta_1\delta_2 M_{t-1} \tag{5}$$

$$ZInv_t=\lambda_0(1-\theta_1+\delta_1)+\lambda_1(\theta_0-\delta_0)+\lambda_1 Cg_t+\lambda_1 Ex_t+\lambda_1 WR_t \\ +\lambda_1\theta_2 Cp_{t-1}+\lambda_2(1-\theta_1+\delta_1)K_{t-1}-\lambda_1\delta_2 M_{t-1} \tag{6}$$

$$ZM_t = \delta_0(1-\theta_1-\lambda_1)+\delta_1(\theta_0+\lambda_0)+\delta_1 Cg_t+\delta_1 Ex_t+\delta_1 WR_t \\ +\delta_1\theta_2 Cp_{t-1}+\delta_1\lambda_2 K_{t-1}+\delta_2(1-\theta_1-\lambda_1)M_{t-1} \tag{7}$$

Where θ_1/Z , λ_1/Z and δ_1/Z represent impact multipliers for consumption, investment and import respectively and $Z = 1-\lambda_1-\theta_1+\delta_1$

Finally, the reduced form equation for income is as follows:

$$Y_t = \Phi + \left(\frac{(\theta_1+\lambda_1-\delta_1)}{Z}+1\right)Cg_t + \left(\frac{(\theta_1+\lambda_1-\delta_1)}{Z}+1\right)Ex_t \\ +\left(\frac{(\theta_1+\lambda_1-\delta_1)}{Z}+1\right)WR_t+\left(\frac{\theta_2}{Z}\right)Cp_{t-1}+\left(\frac{\lambda_2}{Z}\right)K_{t-1}+\left(\frac{\delta_2}{Z}\right)M_{t-1} \tag{8}$$

The short-run or impact multiplier for the income $\left(\left(\frac{(\theta_1+\lambda_1-\delta_1)}{Z}\right)+1\right)$ is

[2] *Capital Stock is approximated by cumulative investment (Pavlopoulos, 1966).*
[3] *Detailed derivation of the model may be provided on demand.*

equal to impact multiplier for consumption θ_1/Z plus impact multiplier for investment λ_1/Z minus impact multiplier for imports δ_1/Z and plus one.

2. Dynamic Multipliers

It is valuable to find out the dynamic effects of workers' remittances on endogenous variables**.** For example a change in remittances by one unit in year 1 with no further increase in the following years 2, 3 ….n, the dynamic multipliers can be obtained. From the reduced form equation (5), consumption function for the following period can written as

$$ZCp_{t+1} = \theta_0(1-\lambda_1+\delta_1)+\theta_1(\lambda_0-\delta_0)+\theta_1 Cg_{t+1}+\theta_1 Ex_{t+1}+\theta_1 WR_{t+1} \\ +\theta_2(1-\lambda_1+\delta_1)Cp_t+\theta_1\lambda_2 K_t-\theta_1\delta_2 M_t$$

Let suppose $\theta_0(1-\lambda_1+\delta_1)+\theta_1(\lambda_0-\delta_0)=C_0$, then

$$ZCp_{t+1} = C_0+\theta_1 Cg_{t+1}+\theta_1 Ex_{t+1}+\theta_1 WR_{t+1}+\theta_2(1-\lambda_1+\delta_1)Cp_t \\ +\theta_1\lambda_2 K_t-\theta_1\delta_2 M_t \tag{9}$$

By substituting (5) into (9) we get:

$$Cp_{t+1} = C_0+\left(\theta_1/Z\right)Cg_{t+1}+\left(\theta_1/Z\right)Ex_{t+1}+\left(\theta_1/Z\right)WR_{t+1}+\left(\theta_1\lambda_2/Z\right)K_t-\left(\theta_1\delta_2/Z\right)M_t \\ \left(\theta_2(1-\lambda_1+\delta_1)/Z\right)*\begin{pmatrix}\left(\theta_1/Z\right)Cg_t+\left(\theta_1/Z\right)Ex_t+\left(\theta_1/Z\right)WR_t+\left(\theta_2(1-\lambda_1+\delta_1)/Z\right)Cp_{t-1} \\ +\left(\theta_1\lambda_2/Z\right)K_{t-1}-\left(\theta_1\delta_2/Z\right)M_{t-1}\end{pmatrix} \tag{10}$$

It can be observed from equation (10) that any change of remittances in the current year has the following effects on private consumption in the following period as:

$$\frac{\partial Cp_{t+1}}{\partial WR_t} = A*\left(\theta_1/Z\right) \quad \text{Where} \quad A=\left(\theta_2(1-\lambda_1+\delta_1)/Z\right)$$

By continuing the process of iteration the dynamic multipliers can be found for the next years as.

$$\frac{\partial Cp_{t+2}}{\partial WR_t} = A^2 * \left(\theta_1 / Z\right), \ \frac{\partial Cp_{t+3}}{\partial WR_t} = A^3 * \left(\theta_1 / Z\right) \ \ldots \frac{\partial Cp_{t+n}}{\partial WR_t} = A^n * \left(\theta_1 / Z\right)$$

Similarly from the reduced form t equation (6), investment function for the following year can be written as

$$\begin{aligned} ZInv_{t+1} &= C_1 + \lambda_1 Cg_{t+1} + \lambda_1 Ex_{t+1} + \lambda_1 WR_{t+1} + \lambda_1 \theta_2 Cp_t \\ &\quad + \lambda_2 (1 - \lambda_1 + \delta_1) K_t - \lambda_1 \delta_2 M_t \end{aligned} \tag{11}$$

Where, $C_1 = \lambda_0 (1 - \theta_1 + \delta_1) + \lambda_1 (\theta_0 - \delta_0)$

let $K_t = K_{t-1} + Inv_t \qquad (P)$

Substituting (6) into (11) by using the identity (P) we get

$$\begin{aligned} Inv_{t+1} &= C_1 + \left(\lambda_1 / Z\right) Cg_{t+1} + \left(\lambda_1 / Z\right) Ex_{t+1} + \left(\lambda_1 / Z\right) WR_{t+1} + \left(\lambda_1 \theta_2 / Z\right) Cp_{t-1} - \left(\lambda_1 \delta_2 / Z\right) M_{t-1} \\ &\quad + \left(\lambda_2 (1 - \theta_1 + \delta_1) / Z\right) K_{t-1} \\ &\quad + \left(\lambda_2 (1 - \theta_1 + \delta_1) / Z\right) * \left(\begin{aligned} &\left(\lambda_1 / Z\right) Cg_t + \left(\lambda_1 / Z\right) Ex_t + \left(\lambda_1 / Z\right) WR_t + \left(\lambda_1 \theta_2 / Z\right) Cp_{t-1} \\ &+ \left(\lambda_2 (1 - \theta_1 + \delta_1) / Z\right) K_{t-1} + \left(\lambda_1 \theta_2 / Z\right) Cp_{t-1} - \left(\theta_1 \delta_2 / Z\right) M_{t-1} \end{aligned} \right) \end{aligned} \tag{12}$$

From equation (12) it is found that any change of workers' remittances in the current year has following effects on investment in the subsequent period.

$$\frac{\partial Inv_{t+1}}{\partial WR_t} = B * \left(\lambda_1 / Z\right) \quad \text{Where } B = \left(\lambda_2 (1 - \theta_1 + \delta_1) / Z\right)$$

By continuing the process of iteration the dynamic multipliers can be found for next coming years as.

$$\frac{\partial Inv_{t+2}}{\partial WR_t} = B^2 * \left(\lambda_1 / Z\right), \ \frac{\partial Inv_{t+3}}{\partial WR_t} = B^3 * \left(\lambda_1 / Z\right) \ldots \quad \frac{\partial Inv_{t+n}}{\partial WR_t} = B^n * \left(\lambda_1 / Z\right)$$

Finally, from reduced form equation (7) import function for the coming year can be found as:

$$ZM_{t+1} = C_2 + \delta_1 Cg_{t+1} + \delta_1 Ex_{t+1} + \delta_1 WR_{t+1} + \delta_1\theta_2 Cp_t + \delta_1\lambda_2 K_t + \delta_2(1-\theta_1-\lambda_1)M_t \qquad (13)$$

Where $C_2 = \delta_0(1-\theta_1-\lambda_1) + \delta_1(\theta_0+\lambda_0)$

Substituting (7) into (13) yields:

$$ZM_{t+1} = C_2 + \left(\delta_1/Z\right)Cg_{t+1} + \left(\delta_1/Z\right)Ex_{t+1} + \left(\delta_1/Z\right)WR_{t+1} + \left(\delta_1\theta_2/Z\right)Cp_t + \left(\delta_1\lambda_2/Z\right)K_t$$
$$\left(\delta_2(1-\theta_1-\lambda_1)/Z\right) * \left(\begin{array}{l}\left(\delta_1/Z\right)Cg_t + \left(\delta_1/Z\right)Ex_t + \left(\delta_1/Z\right)WR_t + \left(\delta_1\theta_2/Z\right)Cp_{t-1} \\ +\left(\delta_1\lambda_2/Z\right)K_{t-1} - \left(\delta_2(1-\theta_1-\lambda_1)/Z\right)M_{t-1}\end{array}\right) \quad (14)$$

From equation (14) it is found that any change of remittances in the current year has the following effects on import in the subsequent period. That is

, $\frac{\partial M_{t+1}}{\partial WR_t} = C * \left(\delta_1/Z\right)$ where $C = \left(\delta_2(1-\theta_1-\lambda_1)/Z\right)$

By continuing the process of iteration the dynamic multipliers can be found for subsequent periods as. $\frac{\partial M_{t+2}}{\partial WR_t} = C^2 * \left(\delta_1/Z\right)$ $\frac{\partial M_{t+3}}{\partial WR_t} = C^3 * \left(\delta_1/Z\right)$ …

$\frac{\partial M_{t+n}}{\partial WR_t} = C^n * \left(\delta_1/Z\right)$

For the income identity, dynamic multipliers can be calculated by summing the multipliers for consumption and investment and then subtracting multiplier for imports from their sum**.**

3. Data Description

Data series for private consumption expenditures, government final consumption expenditures, gross fixed capital formation (private and public sector investments), Exports of goods and non-factor services, import of goods and non-factor services, gross domestic product and worker remittances are obtained from annual report of State Bank of Pakistan and Federal Bureau of Statistics Pakistan. We used cumulative gross fixed capital formation as a proxy for capital stock, for the period of 1973-2007. The level of income is defined as the summation of GDP and workers' remittances.

IV. Empirical Results

We estimated the equations (1), (2) and (3). However, these equations suffered at least with two problems. If these problems are not properly handled, then estimated parameters become biased and inconsistent. The first problem is the endogeniety between private consumption and income variables in the first equation, between investment and income variables in second equation and between imports and income variables in the third equation. If endogeniety is present, then OLS estimates will be biased and inconsistent. The second problem which arises in our equations is the autocorrelation due to the imposition of time aggregation on variables and presence of lagged values of dependent variables as explanatory variables. To solve these problems and obtain consistent estimators and standard error we have used Generalized Method of Moments (GMM) by using data from 1973 to 2007 for Pakistan. The GMM estimates of equations (1), (2) and (3) are given in table 1.

The results indicate that all the coefficients except capital stock are significant. The expected signs are achieved as predicted. The lagged dependent variable in equation (1) and (3), expressing the dynamic nature of the model, are statistically significant. In equation (2), investment behaves as expected, with highly significant coefficient of the income variable. The investment restraining factor of the capital stock has the right behavior but statistically insignificant. We also computed impact and dynamic multipliers from our GMM estimates by using equation (8) and results are summarized in table 2. From the reduce form equation (5), the short-run or impact multiplier for private consumption is equal to $\left(\theta_1/Z\right)$ and computed to be 0.696 implying that one unit increase in remittances in the current year leads to approximately 0.70 unit increase in private consumption expenditures. From the reduce form equation (6), the short-run or impact multiplier is equal to $\left(\lambda_1/Z\right)$ and computed to be 0.386 implying that one unit increase in remittances in the current year leads to 0.386 unit increase in investment. From the reduce form equation (7), the short-run or impact multiplier for investment is equal to $\left(\delta_1/Z\right)$ and computed to be 0.24 implying that one unit increase in remittances in the current year leads to 0.24 unit increase in import. Finally, The short-run or

Table: 1. GMM Estimates of Equation (1), (2) and (3)

Explanatory Variables	Private Consumption Equation	Investment Equation	Imports Equation
Y	0.378* (4.090)	0.210* (3.598)	0.132* (3.954)
CP (-1)	0.541* (4.116)	------	------
K(-1)	------	-0.0018 (-0.0998)	------
M(-1)	------	------	0.339** (2.063)
Constant	15573.92 (0.791)	-30462.57 (-0.599)	12128.80 (0.934)
Adjusted R^2	0.99	0.95	0.94
J-Statistics	2.97	1.65	2.64
J-Statistics Critical	9.48	9.48	9.48
No. of observations	33	33	33
Instrumental Variables	CP(-2) Y(-1) Y(-2) CG(-1) M(-2) WR C	Y (-1) CP (-1) CP (-2) CG (-2) EX (-1) EX (-2) C	IM(-2) Y(-1) Y(-2) CP(-1) CG (-2) WR C

Values of the t-statistics (autocorrelation-hetroskedasticity consistent) are given in the parentheses. J test used for the validity of over identifying restrictions.
*, ** &*** shows Significance level at 1%, 5%, and 10%, respectively.

impact multiplier for the income is equal to $\left({(\theta_1 + \lambda_1 - \delta_1)}\big/{Z} + 1 \right)$ obtained from the reduce form equation (8) and computed to be 1.84, implying that one unit increase in remittances in the current year leads to increase1.84 unit in the level of income through the multiplier effects.

Dynamic multipliers which demonstrate the impact of one unit change in remittances in the current year without any change in subsequent years on the endogenous variables are found for the three years. The dynamic multiplier for private consumption in year 2, 3 and 4 are 0.638, 0.585 and 0.536, respectively. The effect of remittances on private consumption converges gradually toward zero. The dynamic multiplier for investment in year 2, 3 and 4 are -.000963, 0.000002 and -0.000000005, respectively. The effects of remittances on investment wear out in the second year. The dynamic multiplier for imports in year 2, 3 and 4 are 0.0623, 0.0160 and 0.00413, respectively. It is clear that the effect of remittances on investment wears out in the second year but the effect of remittances on private consumption reduces gradually. The effects of remittances on imports reduce in the second year but not as much as investment. For the income identity, dynamic multipliers can be calculated by adding the multipliers for consumption and investment and then subtracting the multiplier for imports from their sum, which is found to be 0.575, 0.569 and 0.532 for second, third and fourth period respectively.

Table: 2. Impact and Dynamic (Interim) Multipliers[4]

	Impacts Multipliers (Short-Run Multipliers)	Dynamic Multipliers		
		Years		
	Year 1	2	3	4
Consumption	0.696	0.638	0.585	0.536
Investment	0.386	-.000963	0.000002	-0.000000005
Imports	0.243	0.0623	0.0160	0.00413
Income	1.838	0.575	0.569	0.532

Finally for calculating the quantities impacts on current and future growth rate of output the estimated dynamic multipliers are applied to the actual annual changes of remittances. For this purpose, for four years time distribution of remittances effects on output growth through the changes in private consumption, investment, and import, the following analytical expression is applied.

$$(Y_t - Y_{t-1}) = \Delta Y_t = \frac{\partial Y_t}{\partial WR_t} * dWR_t + \frac{\partial Y_t}{\partial WR_{t-1}} * dWR_{t-1} + \frac{\partial Y_t}{\partial WR_{t-2}} * dWR_{t-2} + \frac{\partial Y_t}{\partial WR_{t-3}} * dWR_{t-3}$$

According to the results of our study, workers' remittances affect output growth positively. In many years the decline in remittances inflows lead to a positive induced growth rate that is due to the dominant impact of preceding high increases in remittances arising from the dynamic nature of the study. As it is seen from figure-1 that the highest induced growth rate by remittances (8.09%) belongs to the year 1982-83, in that year, remittances contributed about 10.06% of GDP, account 96.6% of the trade deficit and 84.8 percent of

[4] *Since the dynamic multipliers for investment converges to zero in 3 years, so dynamic (interim) multipliers are calculated for 3 years.*

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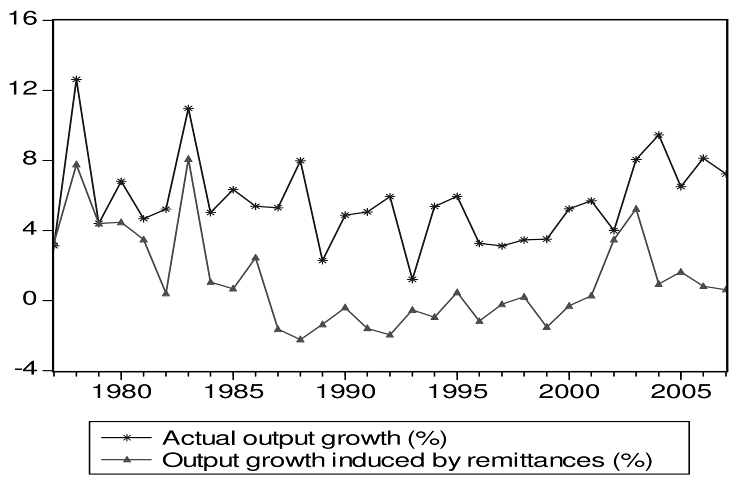
the current account balance (Pakistan Economic Survey, 1983) . It is clearly observed that an induced growth rate in the year 1977 was 3.31 reach to maximum levels in the early 1980s, but it declined in 1990's and mostly with a negative induced growth rate. It is partially due to return of the Pakistani's from Kuwait and Iraq, Gulf crisis and seizing of foreign accounts caused by nuclear explosions, which declined the confidence on banking system of many Pakistanis (Haq, 2001). But induce growth rate in the beginning of the 21st century tends to increase once again and reaches to the maximum in 2003 due to September 11, 2001, remittances have increased very sharply to Pakistan.

Figure-1: Actual rates of output growth and rate of output growth induced by remittances, 1977-2007



V. Conclusions

This study concludes that workers' remittances have played a vital role in the economies of labour exporting developing countries. It constitutes an increasingly means for the transfer of funds from developed to developing nations. As concerned to Pakistan, the remittances were highest during the period of 1982-83 and contributed about 10.06 percent of GDP. After that, it started to decline. It might be due to; migrants returning from Middle East, decline in oil prices, Gulf crises (i.e. invasion of Kuwait by Iraq) and freezing of foreign currency account due to explosion of nuclear weapon. After experiencing a slump in the 1990s, remittances to Pakistan are again increasing. At the beginning of 21st century, remittances have increased very sharply during the period of 2001-02 to 2002-03, then, it decreases in 2003-

04. Afterward, remittances sent home by migrants showed a rising trends.

The study focused mainly on the dynamic impact of workers' remittances on economic growth through consumption, investment and imports in Pakistan. A Keynesian macro-econometric demand-oriented simultaneous equation model with a dynamic perspective consisting of three behavioral equations (private consumption, investment and import), national income identity is also included. First, we estimated the consumption, investment and imports equations by employing "Generalized Method of Moments (GMM)" and obtained short and long-run marginal propensities to consume (MPC) and marginal propensities to import (MPI). From the reduced form equations of consumption, investment and imports short-run multipliers are obtained, which are used to find the short-run (impact) multiplier for income. These findings demonstrate that one unit increase in workers' remittances in the current year leads to a 1.84 unit increase in the level of income through multiplier effects.

Dynamic multipliers are found for the following 3 years for the investigation of long-run multiplier effects of exogenous shocks of workers' remittances on private consumption, investment, import and therefore output growth. The effect of remittances on investment wears out in the second year but the effect of remittances on private consumption reduces gradually. Finally, the estimated dynamic multipliers are applied to the actual annual changes of remittances for calculating the quantitative impact of current remittances on current and future growth rates of output. For this purpose, 4 year time distribution of remittance effect on economic growth through the changes in consumption, investment and imports is analyzed.

The results point out that worker's remittances effect economic growth positively through multiplier process. In several years, the reduction in remittances leads to a positive induced growth rate due to the dominant impact of preceding high increases in remittances. Our analysis shows that, although the workers' remittances used mostly for private consumption and partially for imports but it contributed to the economy of Pakistan positively through multiplier process.

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Incidence of Education and Health Services on Different Income Classes in Pakistan

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Abstract

This study investigates the incidence of education and health services on different income groups in Pakistan using HIES data set 2001-02. This study uses Kienzle (1981) index to measure the incidence of such services for overall Pakistan, its rural-urban segments and four provinces of Pakistan. The findings of the study indicate that both services are pro-poor. It implies that the lower income classes enjoy the benefits which can hopefully improve the relative income positions of the beneficiaries. This study further confirms the previous results by estimating Gini index of gross income and after adding both the services. The results are bootstrapped in order to build confidence interval for the estimated indices as the point estimates are not reliable for policy prescriptions.

I. Introduction

Income inequalities do prevail almost in every society with in a variety of degrees. It stems social disharmony among people. In this regard it is the responsibility of every government to generate sufficient revenues and also to cater for the needs of lower income groups in order to bring harmony among people. Negative income taxation and /or transfer payments are the ways to address this problem. To supplement the efforts mentioned above the basic social services provided to people at large are health and education due to which the relative income position can be enhanced.

Pinpointing the beneficiaries of these social services needs distributional analysis in the economy of Pakistan. If these social benefits accrued to the lower income strata, their relative income position can definitely be improved. Several indices have been implied in the literature like Kienzle (1984) following the widely used tax distributional index of Suits

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(1977) which are based on Lorenz Curve and Gini Coefficient. The empirical work on this theme in developed and developing countries are Kakwani (1976), Reynolds et.al. (1977), Paul (1991), Seldon et.al. (1992), Devarajan et. al. (1995), Vanquez- Martinz (2001), Pinar (2004), Johannes (2005) and Berg (2005), who have different methodologies to analyze fiscal incidence and / or education and health benefits incidences on different income classes. The estimates of these indices shall exhibit progressivity or regressivity for overall Pakistan, its rural-urban segments and of four provinces. The estimated values of the index are point estimates which are hardly beneficial for policy purposes. This problem can be handled by constructing the standard errors of the estimated index values for all the region of analysis in order to build confidence interval at a reasonable level of significance.

The organization of the study is as follows; following introduction, Section II outlines methodology of the study. Section III describes data sources while Section IV elaborates the results. Lastly two appendices and references are placed.

II. Methodology and Data Sources of the Study

The methodology adopted for the allocation of education and health expenditures to individuals who are actually receiving these benefits is taken from the Household Income and Expenditure Survey (HIES) data 2001-02. In this regard, the unit cost of education services provided is estimated from the Demands for Grants of Federal and Provincial Governments for the year 2001-02. The data on health per unit cost for all the regions of analysis are taken from Sustainable Policy Development Centre (SPDC) Karachi 2001.

The net income distribution is constructed by applying the following methodology.

Net or Adjusted Income of the Household = Household's Market Income + (All Government Spending – All Tax Burdens)

The beneficiaries are traced and the allocations are made according to the level and regional classification. The education expenditures are allocated by using the following expression:

$$XE_i = \sum_{j=1}^{5} \mathrm{E}D_{ij}\left(\frac{C_j}{E_j}\right) \tag{1}$$

Here, the XE_i equals the amount of expenditures / benefits on education received by i[th] household; ED_{ij} equal i[th] household member in j[th] education level/sector. C_j and E_j stands for total public expenditures on education at j[th] level and total sector/level-wise enrollment for various levels of education. Note that $\frac{C_j}{E_j}$ is the unit cost per student at different educational level and at overall and provinces levels and that the levels of education are primary, secondary, college, professional and higher education.

Similarly the health expenditures are allocated by using the following expression:

$$XH_i = \sum_{j=1}^{6} HH_i \left(\frac{EH_j}{TP_j} \right) * W_j \qquad (2)$$

In this equation, the XH_i equals the amount of expenditures / benefits on health received by i[th] household; where the household consists of age-wise distribution of individuals at different levels. Similarly, EH_j stands for total public expenditures on health on j[th] age group and TP_j is total number of patients in j[th] age group in a particular region; HH_i is the i[th] household member of being patients who attend public hospitals for treatment and, W_j stands for weight for j[th] age group. In addition, residents less than ten years and above sixty years old and females within the age limit of fifteen to fifty years have been allocated double weight. The weight for male/female patients below the age of ten and above sixty years and females within the age group of fifteen years to fifty is double as they are more vulnerable to diseases.[2] While male within the age group between ten and sixty and females within the age group between ten to fifteen year and above fifty to sixty year are given single weight. Note that $\frac{EH_j}{TP}$ is the unit cost per patient at different regional levels, e.g., at overall and provinces levels.

The data used in this study is taken from HIES 2001-2002, which is conducted by the Federal Bureau of Statistics having sample size of 14,767**.** The benefit of this type, i.e., micro data is an ideal option that enables a

[2] *According to recent World Health Organization (WHO) report the reproductive age of females are between 15 to 49 years. So it justifies our weightage structure that they face more health problems during this age group.*

researcher to manipulate the data according to the need of the research problem. In addition, micro data files contain weighting factors that are designed to obtain the nationally representative estimates of population. Tax rates on customs duty, central excise, and sales tax rates are taken from Central Board of Revenue (CBR) sources. The income tax rates are implied from the notifications for various income brackets of Ministry of Finance (Government of Pakistan), for the two years 1992-93 and 2001-02, with the information that Rs.50,000 in 1992-93 and Rs.80,000 in 2001-02 was exempted from the tax. The information whether a good or service is taxed or otherwise is taken from CBR Year Book of the year 2001-02. The data on public expenditure provided by the government such as education are taken from the Demand for Grants at National and Provincial levels for the year 2001-02 and health from the SPDC Karachi for the year 2001.

III. Empirical Results

The results of our analysis are reported in the following table. The value of the Kienzle index is negative for all the region of analysis for both the government provided services. It shows that both education and health are progressive which favor the low income classes in year 2001-02. However, the degree of progressivity differs across regions. For example education in overall Pakistan is mostly progressive as the index value is -0.222 followed by NWFP. Punjab ranks on number three followed by Pakistan urban and Balochistan. The only province which lags behind is the Province of Sindh. Health expenditures are also progressive throughout. These expenditures are strongly progressive in the Province of Sindh as the index value is -0.654 followed by Pakistan - urban. Overall Pakistan is number third followed by NWFP and Punjab. The second and third last regions according to progressivity are Pakistan-rural and the Province of Balochistan.

1. Confidence Interval for the Kienzle Indexes 2001-02

In table 1, each value represents a single value or a point estimate which can hardly to be used for policy purposes. Hence confidence intervals are built to make it more reliable estimates. The standard procedure which has been followed is known as bootstrapping contributed by Efron (1979). Table.2 reports the bootstrap results of the above mentioned estimates for 2001-02. The mean bootstrap estimates of education expenditure for all the regions are reported in the first row. Since the 250 bootstrap replications have been applied; the estimated bootstrap estimates are not fully compatible with the original Kienzle index values. The second row reports the standard errors of the estimated bootstrap values. The next two rows show the lower and upper bound for 95% confidence level. Similarly, the fifth row of Table 2 reports the mean bootstrap estimated Kienzle index of health expenditures for all the regions of analysis. Next row shows the standard errors of the estimates followed by lower and upper bounds at 95% confidence level for the health expenditures.

Table: 1. Kienzle Indices Showing Progress of Education and Health for Year 2001-2002

	Pakistan - overall	Pakistan - Rural	Pakistan - Urban	PUNJAB	SINDH	NWFP	BALOCHISTAN
Expenditures	**K I E N Z L E I N D I C E S**						
Education	-0.222	-0.150	-0.199	-0.207	-0.128	-0.220	-0.173
Health	-0.330	-0.280	-0.353	-0.299	-0.654	-0.307	-0.224

Sources: Author's estimation by using HIES data 2001-02 and applying Kienzle index.

Table: 2. Bootstrap Results of Kienzle Indices of Education and Health for Year 2001-2002

Regions of Analysis			**Pakistan - overall**	**Pakistan - Rural**	**Pakistan - Urban**	**PUNJAB**	**SINDH**	**NWFP**	**BALOCHISTAN**
Category of Expenditures	**Unit of Analysis**		**K I E N Z L E I N D I C E S**						
Education	Bootstrap Estimated Kienzle Index		0.130	-0.040	0.020	0.050	0.010	0.000	-0.020
	Standard Errors		0.040	0.030	0.040	0.030	0.040	0.030	0.030
	(95 %CI)	Lower Bound	0.050	-0.100	-0.020	-0.020	-0.070	-0.070	-0.090
		Upper Bound	0.200	0.020	0.120	0.120	0.080	0.070	0.050
Health	Bootstrap Estimated Kienzle Index		0.090	-0.020	0.050	-0.030	-0.210	0.010	-0.020
	Standard Errors		0.030	0.040	0.040	0.030	0.040	0.030	0.040
	(95 %CI)	Lower Bound	0.030	-0.090	-0.100	-0.100	-0.280	-0.060	-0.090
		Upper Bound	0.160	0.050	0.030	0.030	-0.140	0.070	0.060

Source: Author's estimation by applying 250 replications using HIES data 2001-02.

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2. Diagrammatical representation of the Incidence of Education and Health Expenditures on Income Groups in Year 2001-02

Figure 1 and 2 shows the distributional impact / incidence of education and health for overall Pakistan. The Lorenz curves show that both the expenditures are progressive or pro-poor as the curves are tilted to the left of

Figure 1: Lorenz Curve of Education Expendirue for Overall Pakistan 2001-02

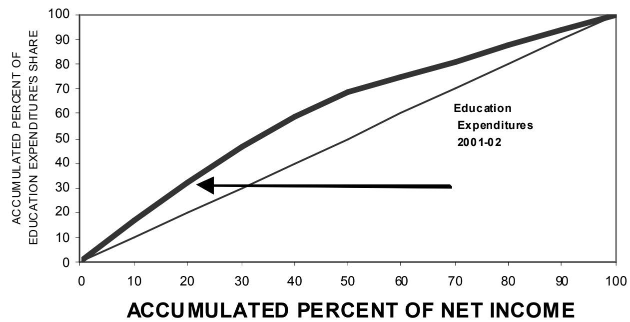
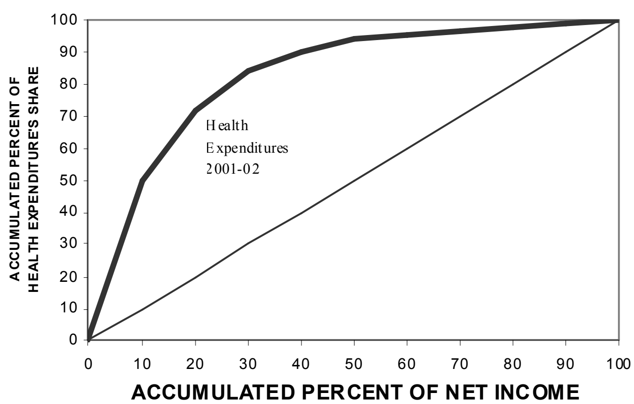


FIGURE.2: LORENZ CURVE OF HEALTH EXPENDITURES FOR OVERALL PAKISTAN 2001-02



perfectly equality line. But the health expenditures are more progressive than education in year 2001-02. It also shows that the lower income groups avail public education system provided by the government. Similarly, health facilities are also enjoyed by the lower income groups as well. The figures of the remaining regions of analysis have been placed in the Appendix of the study. This appendix shall also comprise of the expression of Kienzle index and other theoretical issues. To confirm the results already obtained, table 3 shows that the inequality of gross income is slightly more than the after inclusion of education and health expenditures of the government of each region. It implies that education and health expenditures are pro poor in Pakistan in the year 2001-02. The diagrammatical representation has been placed in the Appendix 3.

Table: 3. GINI Index of Income Before and After Education and Health for the Year 2001-02

Region	Pakistan-overall	Pakistan-Rural	Pakistan-Urban	PUNJAB	SINDH	NWFP	BALOCHISTAN
Gini index (before)	0.565	0.592	0.532	0.581	0.562	0.593	0.546
Gini index (After)	0.562	0.588	0.528	0.579	0.560	0.587	0.545
Difference	-0.003	-0.004	-0.004	-0.003	-0.002	-0.006	-0.001

Sources: Author's estimations

V. Summary and Conclusions

The aim of this study is to analyze the distributional impacts of the two social services provided by government to various income groups using HIES micro data set of 2001-02. These two categories are related to the allocable government expenditures. The beneficiaries of both of these expenditures are traced by using the above mentioned data. Per unit cost of service approach for the allocation of these benefits have been used. On the average out of total number of surveyed 16,179 households, 15,524 benefit from public education and public health provided facilities. The results show that both are progressive in nature for all the regions of analysis. The results also suggest that apart from other measures of government, the provision of education and health can probably lesson income disparities in Pakistan. The results are further confirmed by estimating the Gini index of gross income before and after the inclusion of these services. All the tables are placed after summary and conclusions section and the graphs are places in the Appendices. This study investigates the overall situation about the nature of distribution for the said social services. Hence estimation of effective rates for each income group might be undertaken in future.

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Appendix: 1

A. 1: Expenditures Progressivity/ Regressivity

An expenditures / benefits structure is progressive or pro-poor if the lower income deciles receive most of the expenditures / benefits or receive larger share in the public expenditure than their income share of the total population. And this will be called income equalizing or pro-poor expenditures / benefits structure. The expenditures / benefits structure is regressive if the upper income deciles receive most of the expenditures / benefits or receive larger share in the public expenditure than their income share of the total population, implying regressivity of the expenditures structure or income non-equalizing or pro-rich expenditures / benefits structure. It will be proportional if all the income deciles receive the same percentage share in the public expenditure in accordance with the share of their incomes, then it is termed as distributionally neutral expenditure of benefit system.

A. 2: Public Expenditure/Benefit Distributional Index

This index of expenditure / benefit progressivity / regressivity (E) suggested by Kienzle, (1981) is nothing but a replication of the well-known Suits index by replacing tax with public expenditures or benefits.

$$E = (X - Y) / X = 1 - (Y / X) \qquad \text{(A.1)}$$

The mathematical formulation of the above expression is as follows:

$$E = 1 - (1/5000)\int_{0}^{100} E(Y)dy \qquad \text{(A.2)}$$

Where Y and E(Y) are the cumulative percentage of total income and the corresponding cumulative percentage of expenditure / benefit. The (1/5000) term in the above expression comes from the area of the triangle below the perfect equality line whose both sides are equal to100 each. Where as in reality the cumulative distribution of E(Y) is often available for only a few discrete values of Y. To use this index (E) practically, the studies divide the distributions of income and expenditures e.t.c., into classes or groups. In this study the entire data set of the two reference years has been grouped into deciles. So this discrete approximation of the Suits index is given by the following expression:

$$E = 1 - (1/5000)\int_{0}^{100} E(Y)dy \cong 1 - (1/5000)\sum_{i=0}^{n=10} (1/2)\left[E(Y_i) + E(Y_{i-1})\right]\left[Y_i - Y_{i-1}\right] \qquad \text{(A.3)}$$

Where n shows the total number of income or taxpayer’s classes or deciles. The two extreme values of index E are to equal −1 and +1. If E equals -1, it shows (extreme progressivity), and that the lowest income group / class receive the entire public expenditure / benefit. When E equals 1, it shows (extreme regressivity), that the uppermost group / class receive the total public expenditure / benefit. A 0 value of the index (E), shows that the expenditure/benefit structure is proportional. It is also important to be careful in its application because the proposed measure may encounter the problem of "crossover". It is possible that some expenditure structure may be progressive over one range and regressive over another range and the net result may show a value of index equals 0 implying proportionality.

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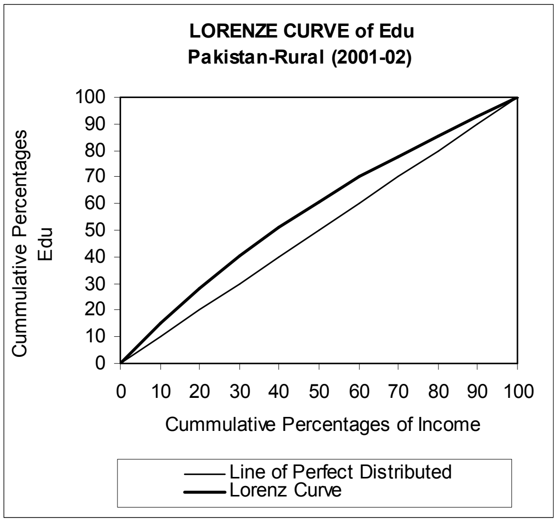
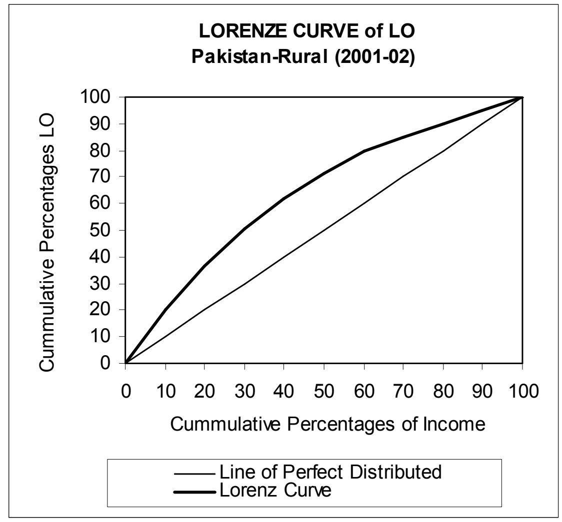
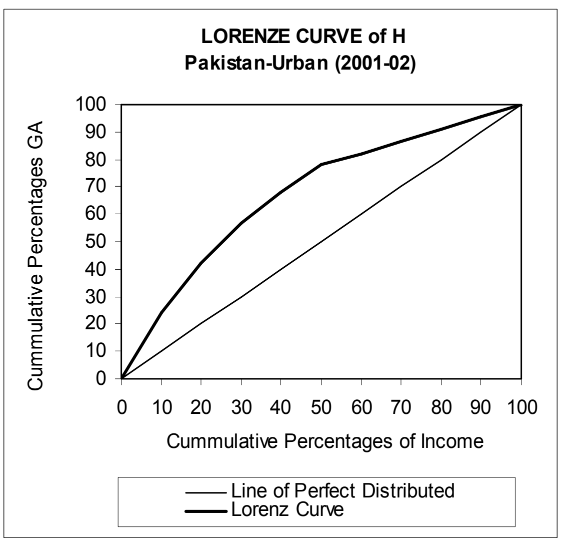
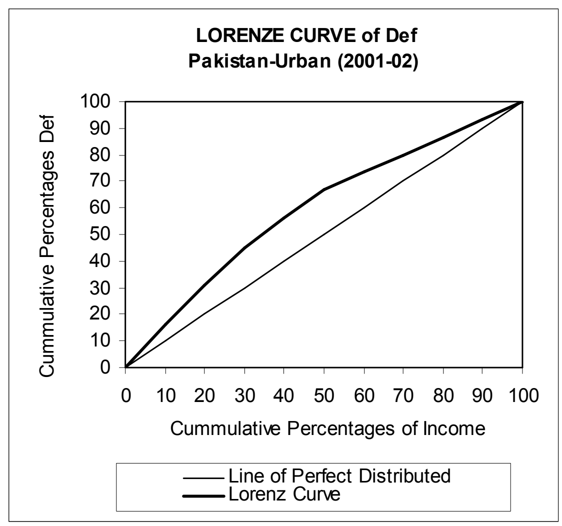
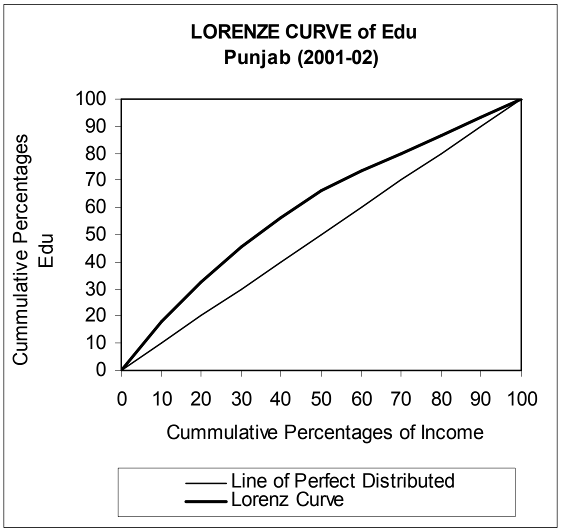
Appendix: 2
Lorenz Curves of Education and Health for all Regions of Pakistan for the Year 2001-02.

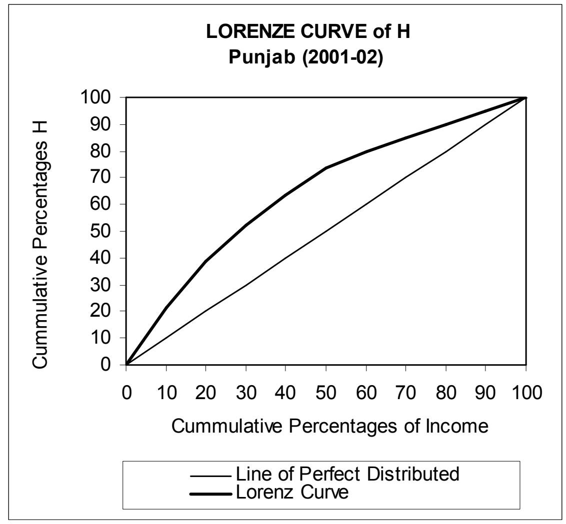


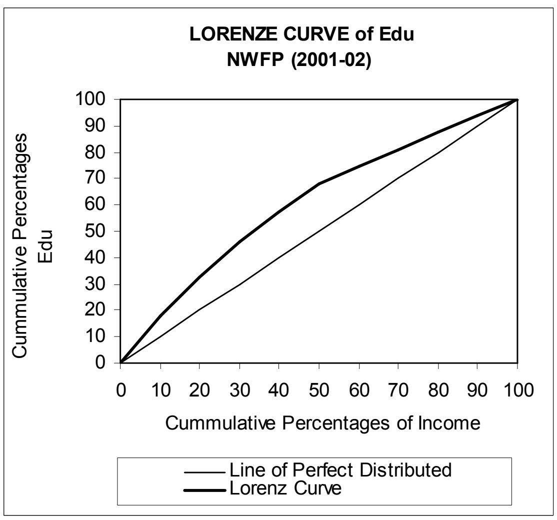


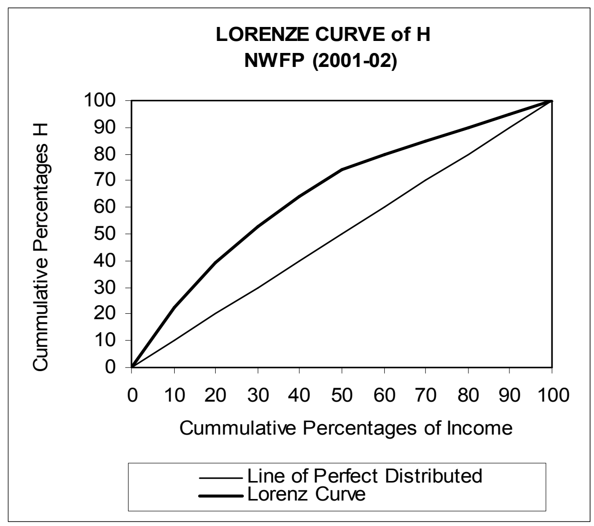


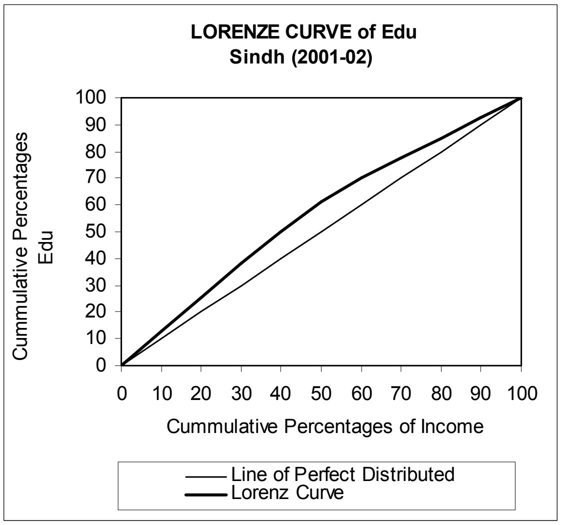


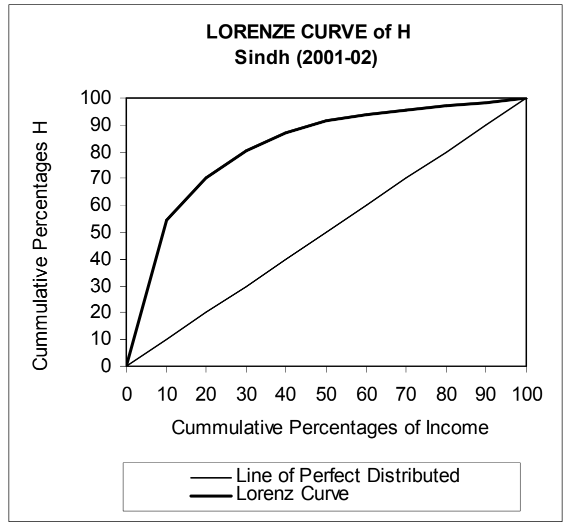

LORENZE CURVE of Edu
Punjab (2001-02)
Cummulative Percentages Edu
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of H
Punjab (2001-02)
Cummulative Percentages H
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of Edu
NWFP (2001-02)
Cummulative Percentages Edu
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of H
NWFP (2001-02)
Cummulative Percentages H
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of Edu
Sindh (2001-02)
Cummulative Percentages Edu
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve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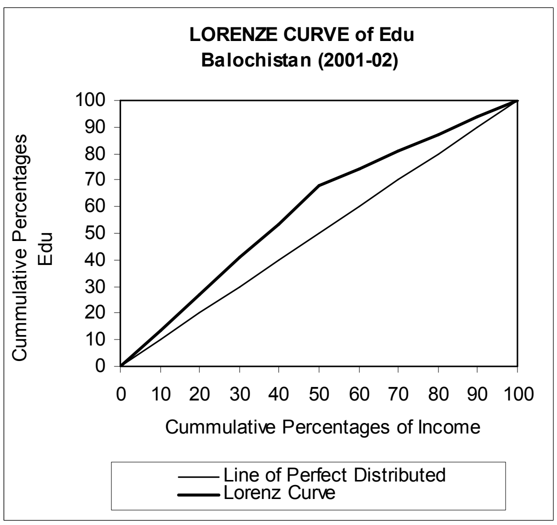
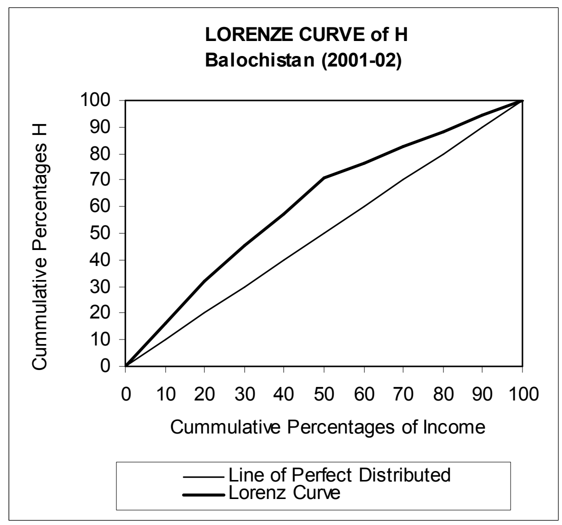
Cummulative Percentages H
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of Edu
Balochistan (2001-02)
Cummulative Percentages Edu
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve


LORENZE CURVE of H
Balochistan (2001-02)
Cummulative Percentages H
Cummulative Percentages of Income
Line of Perfect Distributed
Lorenz Curve

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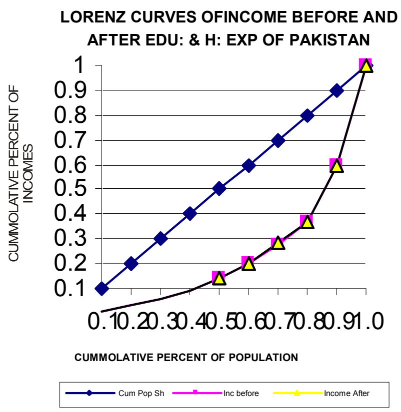
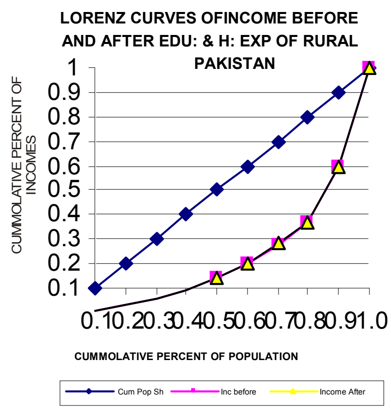
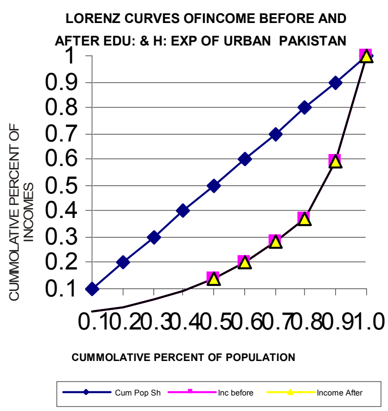
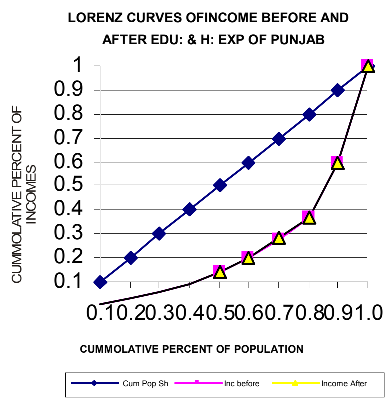
Appendix: 3
Graphs of Lorenz Curves Income before and after Education and Health









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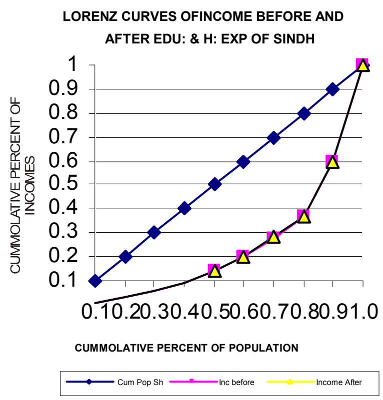

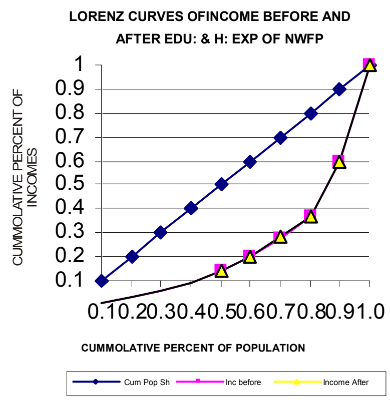

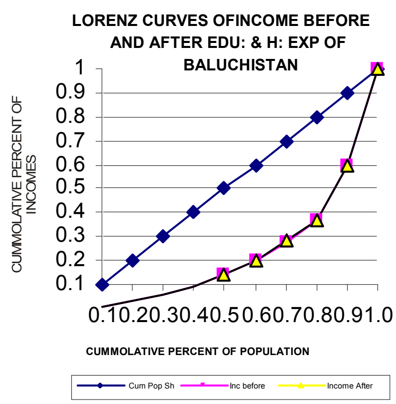

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Saving Growth Nexus in Pakistan: Innovation Accounting Technique

Mohammad Shahbaz and Rana Ejaz Ali Khan[1]

Abstract

The paper investigates the relationship between economic growth and domestic savings. We used ARDL Bounds Testing and Johansen Cointegration approaches for long-run association, and Innovation Accounting Technique along with Toda and Yamamoto (1995) for causal relationship using annual time series data for the period 1971 to 2007. Ng-Perron De-trended Test is used to determine the order of integration among data series. Results reveal that there exists a long-run relationship between economic growth and domestic savings. Causal results through innovation accounting technique assert that there is one-way causality, running from economic growth to domestic savings while very weak from opposite side. Results by Toda and Yamamoto's technique also confirm that economic growth leads domestic savings in Pakistan.

I. Introduction and Background of the Issue

According to Lewis's (1955) conventional development theory 'savings stimulate the economic growth through investment activities' while saving behavior also encourages the economic growth (Kaldor 1956; Samuelson & Modigliani 1966). In 1990s, contrary to conventional theory a new aspect emerged, i.e., 'savings contribute to accelerate investment which enhance Gross Domestic Product (GDP) in short span of time' (Bacha 1990; DeGregorio 1992; Jappelli & Pagano 1994). A number of studies showed that economic growth encourages the savings (see for instance, Sinha & Sinha 1996; Sinha & Sinha 1998; Salz 1999; Anoruo & Ahmad 2001; Ramesh 2006; Sinha & Sinha 2007). Edwards (1995) argued that economic growth is one of

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the most important determinants of not only private savings but also of public savings.[2]

In economic literature, researchers have used different econometric techniques and probed the issue. For example, several economists (e.g., Bacha 1990; Otani & Villanueva 1990; DeGregorio 1992); and Jappelli & Pagano 1994) have employed Ordinary Least Squares (OLS) method using cross-sectional data and concluded that higher savings leads to higher economic growth. Recently, Krieckhaus (2002) argued that increased national savings leads to higher investment and hence contribute to higher economic growth. The concept of Granger-causation in this area was introduced by Caroll & Weil (1994). They concluded that economic growth causes high savings. Using five-year averages of the economic growth rate and savings for OECD countries, Attanasio, et al. (2000) argued that using annual data rather than the five-year average increases exactness and significance of empirical estimation as well as direction of causal relation.

Sinha and Sinha (1996) found that economic growth leads to higher savings and it is particularly true in the case of a developing economy such as Pakistan. Sinha and Sinha (1998) investigated the causal relationship between economic growth and savings for Mexico and found that it runs from economic growth to savings.[3] In 2007, they also investigated the same relationship for Philippines and concluded that economic growth leads to higher domestic savings. On the other hand causality was found from gross domestic savings to economic growth for Sri-Lanka (Sinha and Sinha 1999). Saltz (1999) investigated the causal relationship between the same variables by employing Vector Error Correction (VEC) and VAR (Vector Auto Regressive) model. The study concluded that higher growth rate of real GDP contribute to higher growth of savings. Anoruo and Ahmad (2001) employed VEC to find out direction of causality between savings and economic growth in seven African countries. They found a bi-directional causality for Cote d'Ivoire and South Africa. Only for Congo, the growth rate of domestic savings leads economic growth.

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[2] *Caroll, et al. (2000) demonstrated that 'if utility depends partly on how consumption compares to a habit stock determined by past consumption, an otherwise-standard growth model can imply that increase in growth can cause increased saving'.*

[3] *Triantis (1997) questioned the validity of the life cycle model.*

Mavrotas and Kelly (2001) investigated direction of causal relationship among gross domestic product, gross domestic savings, and private savings through employing Toda and Yamamoto (1995) technique for India and Sri Lanka. They concluded that for India no causality between GDP growth and private savings exists while for Sri-Lanka bi-directional causality prevails. Agrawal (2001) examined the causality between GDP and saving for a number of Asian countries and concluded that for most countries causality flows from GDP to saving. Countries like Singapore, South Korea, Malaysia, Thailand, and the Philippines were investigated by Baharumshah, et. al. (2003). The study employed VEC on time series data from 1960-1997 and found that there is no causality between gross domestic savings and economic growth except for Singapore. Ramesh (2006) determined the direction of same type of causality for high income countries, lower middle countries, upper middle countries and lower income courtiers and supported the hypothesis that economic growth leads to higher gross domestic savings. The relationship between savings and growth is differing for economies due to their economic structure and possibly due to different research techniques. To entangle the relationship of Pakistan, it is attempted by new techniques and fresh data.

The present study is an innovational addition in the literature due to its difference from existing literature. It is different from the previous ones in the following aspects; long-run association and its robustness is examined through ARDL Bounds Testing and Johansen Cointegration techniques, for direction of causality Innovation Accounting Technique and Toda and Yamamoto (1995) is employed and to check the order of integration of variables, Ng-Perron (2001) is applied. The organization of the study is as follows; following introduction, Section II outlines methodology of the study. Section III describes results and discussion while section IV provides conclusions of the paper.

II. Methodology

Vector Auto Regression (VAR) approach is commonly used to investigate the dynamics of the relationship between two macroeconomic variables, as well as for the other variables such as gross domestic savings and economic growth. VAR is usually applied to avoid shortfalls of endogeniety and integrating order of variables**.** The present endeavor is different as it would employ Innovation Accounting Technique (Impulse Response Function and Variance Decomposition) to investigate causal relationship. It is based on the property that forecast error variance decomposition allows inferences to be concluded with reference to the proportion of movements in particular time periods due to its own shocks and shocks arising from other variables in the VAR. By using VAR, impact of a shock can be checked in a particular variable traced through the system of equations that determine the impact on other variable and also variables that include future values of shocked variables.

This approach breaks down the variance of the forecast error for each variable following a shock to particular variable that makes possible to identify which variable affects strongly and vis-à-vis impact. For example, a shock in economic growth leads subsequently to a change in gross domestic savings in the estimated VAR approach, but shock in gross domestic savings has only minor or small effect on economic growth, from this exercise, we can infer and conclude that economic growth leads gross domestic savings or causality runs from economic growth to gross domestic savings.

On the other hand, impulse response function investigates the time path of the effects of shocks of independent variables. This approach also determines, how each actor responds over time to the first shocks in other variables. So these two methods are named as Innovation Accounting that allows an intuitive insight into the dynamic relationship between gross domestic savings and economic growth. They are applied on the annual time series data for the years 1971-2007 for Pakistan.

According to variance decomposition, it breaks down the forecast error for gross domestic savings and economic growth, if gross domestic savings explain more of the variance**,** then, in accordance with the above discussion, a VAR system is established for the present study that makes following model:

$$V_t = \sum_{i=1}^{k} \delta_i V_{t-1} + \eta_t \qquad (1)$$

Where, $V_t = (LEG, LGDS)$, and $\eta_t = \langle \eta_{LEG}, \eta_{LGDS} \rangle$, $\delta_1 - \delta_k$ are two by two matrices of coefficients and η is a vector of error terms. LEG = log of economic growth peroxide by income per capita and LGDS = log of gross domestic savings as share of GDP.

III. Results and Discussion

Ng-Perron (2001) test is employed to investigate the order of integration for the said actors. The results of unit root test at level and at 1st difference with constant and trend are shown in table-1. The values of *MZa, MZt, MSB & MPT* are greater than critical values indicating non-stationary at level. Results at the 1st difference show that both variables are stationary. It concludes that economic growth and gross domestic savings are having *I(1)* order of integration.

Table-1: Variable's Order of Integration

Ng-Perron at Level				
Variables	MZa	MZt	MSB	MPT
LEG	-9.1833	-2.0172	0.2196	10.3964
LGDS	-10.624	-2.2484	0.2116	8.84327
Ng-Perron at 1st Difference				
LEG	-16.9357	-2.9052	0.1715	5.4087
LGDS	-31.4951	-3.8847	0.1233	3.3594

*Ng-Perron (2001, Table 1)

After obtaining the order of integration of running actors, table-2 and 3 show evidences of the existence of long-run relationship between gross domestic

Table-2: ARDL Estimation with Parsimonious Model Results

ARDL with Constant & Trend			
Dependent Variable	**F-Statistics**	**Wald- Statistics**	**Chi-square**
LEG	*11. 284*	8.889 (0.0013)	17.778 (0.0001)
LGDS	5.798	3.349 (0.0522)	6.698 (0.0351)
Critical Bounds	**Instability Level**	***Lower Bound***	***Upper Bound***
	1%	8.74	9.63
	5%	6.56	7.30
	10%	5.59	6.26

Pesaran, et, al (2001)

Table-3: Johansen First Information Maximum Likelihood Test for Co-integration

Hypotheses	Trace-Test	5% critical value	Prob-value**	Hypotheses	Max-Eigen Statistic	5% critical value	Prob-value
R = 0	35.4882	18.3977	0.0001	*R = 0*	33.5729	17.1476	0.0001
R ≤1	1.91531	3.8415	0.1664	*R= 1*	1.91531	3.8415	0.1664

**MacKinnon, et al. (1999) p-values.

savings and economic growth in Pakistan.[4] ARDL bounds testing approach is intimating the one co-integrating vector between variables like Johansen First Information Maximum Likelihood Test for Co-integration.Table-4 shows that how the forecast error variance of the variables can be broken down into components that can be attributed to each of our variables in VAR. It shows the exact explanations about their relationship through innovation shocks while forecast error variance decomposition of unrestricted VAR (3) models are estimated over a 10-year forecast time horizon.

From the test it may be concluded that each time series describes the prevalence of its own values. Economic growth explains more than 97 percent of its forecast error variances that is explained through its own innovative shocks, whereas, gross domestic savings show innovative impact through its own shocks by nearly 58 percent. It shows that economic growth is predominantly explained by its past values or innovative shocks and mildly through gross domestic savings. It may also be concluded that current economic growth influences future growth trends. Gross domestic savings lead economic growth not more than 3 percent through its innovative shocks while economic growth leads gross domestic savings by more than 42 percent through their innovative shocks on each. The phenomenon explained that there is one-way causality running from economic growth to gross domestic savings. It is supported by Sinha and Sinha's (1996) arguments for Pakistan based on simple Granger causality approach.

Table-4: Variance Decomposition Percentages of 35-Year Error Variance

	Typical Shocks in	
Percentage of Forecast Error Variation in	LEG	LGDS
LEG	97.30	2.70
LGDS	42.11	57.89
Toda and Yamamoto for Granger Causality		
Variables	LGNPC	LGDS
LEG	-	0.058
LGDS	8.065*	-

[4] *Methodological Framework of both ARDL and Johansen Co-integration approaches is given in Appendix-A.*

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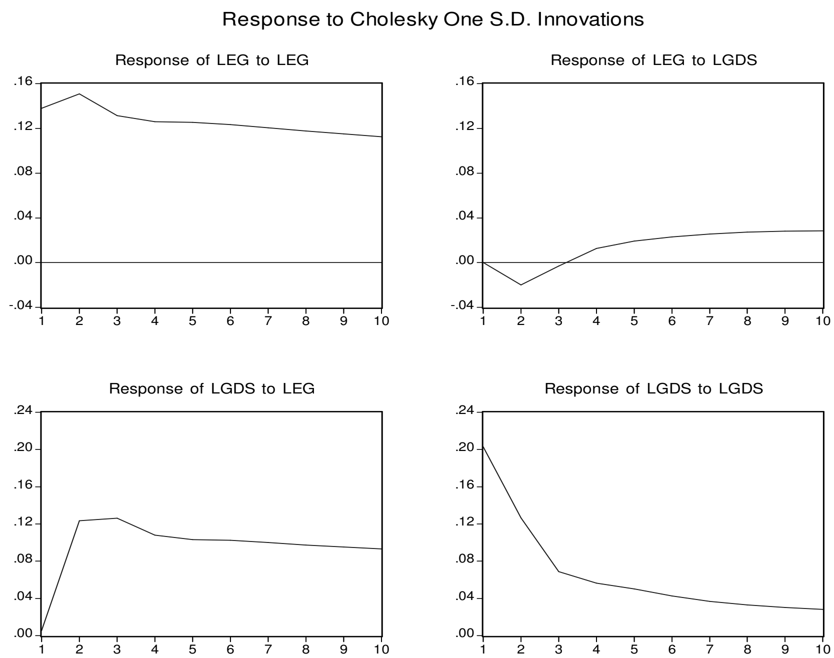
To test the robustness of the causality between economic growth and domestic savings Toda and Yamamoto (1995) technique has also been employed.[5] The results of table-4 show that only economic growth leads the gross domestic savings but gross domestic savings has no causal relation with economic growth. The results are matching with the results by Innovative Accounting Techniques.

Finally, Impulse response function is utilized to investigate the time paths of log of economic growth (LEG) in response to one-unit shock to log of gross domestic savings (LGDS) and vice versa. A graphical representation of impulse response function provides a spontaneous insight into dynamic relationships as it shows that how economic growth responds over time to a shock in gross domestic savings and vice versa.

Figure-1: Impulse Response Functions



[5] *One of the shortcomings of the Granger causality test procedure is that the variables used in the test must be stationary. While the main advantage of Toda and Yamamoto (1995) is that it allows for the variables in the VAR to be non-stationary or even co-integrated. It, therefore, allows us to test for causality between the levels of economic growth with domestic savings even though, if both actors are known to be non-stationary.*

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IV. Conclusions

The main focus of this study was to investigate the long-run relationship between economic growth and savings in Pakistan. For the purpose ARDL, Bounds and Co-integration techniques were applied. The results explain that in the case of Pakistan, there prevailed not only long-run relationship between economic growth and gross domestic savings but also the robustness of relationship in long span of time. To find out the direction of causality, Innovation Accounting Approach and Granger-causality by Toda and Yamamoto (1995) were applied. Both results suggest that economic growth leads to the gross domestic savings that means the direction of causality is from economic growth to domestic savings but there is no response from opposite side. It explains that Pakistan's society is a consumption society and has fewer tendencies to save at micro and macro level for national investment.

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Appendix-A

A1. ARDL Bounds Testing Procedure

The ARDL approach to cointegration is selected as it performs better in small sample sizes than other cointegration techniques. Besides, it is applicable irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$ or mutually co-integrated.[6] The statistic underlying this procedure is similar to Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium error correction model (ECM) (Pesaran, et. al. 2001). The ARDL approach involves estimating the following Unrestricted Error Correction Model (UECM):

$$\Delta Y_t = a_\circ + \sum_{i=1}^{p} \alpha_1 \, \Delta Y_{t-i} + \sum_{i=1}^{p} \alpha_2 \, \Delta X_{t-i} + \beta_1 \, Y_{t-1} + \beta_2 \, X_{t-i} + \varepsilon_{1t} \qquad (2)$$

Where Δ is the difference operator, p represents the lag structure, Y_t and X_t are the underlying variables, and ε_{1t} and ε_{2t} are serially independent random errors with mean zero and finite covariance matrix. The null hypothesis is H_0: $\beta_1 = \beta_2 = 0$, i.e. there exists no long-run equilibrium relationship, and the alternative hypothesis is H_1: $\beta_1 \neq \beta_2 \neq 0$ (Pesaran, et. al. 2001). These hypotheses are tested using the F-test. However this test has non-standard distributions depend on the sample size, the inclusion of intercept and trend variable in the equation, and the number of regressors. The estimated ARDL test statistics are compared to two asymptotic critical values reported in Pesaran, et. al. (2001:300-304) rather than to conventional critical values. If the test statistic is above than upper critical value, the null hypothesis of long-run relationship can be rejected regardless of the orders of integration of the underlying variables. The opposite is the case if the test statistic falls below a

[6] *The second advantage of using the bounds testing approach to Co-integration is that it performs better than Engle and Granger (1987), Johansen (1988) and Philips and Hansen (1990) Co-integration test in small samples (see, e.g., Haug 2002). The third advantage of this approach is that, the model takes sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson and Chai 2003). However, Pesaran and Shin (1999) contented that 'appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous variables.'*

lower critical value. If the sample test statistic falls between these two bounds, the result is inconclusive.

A2. Johansen Co-integration

In order to test the robustness of the results, we also applied the traditional Johansen Co-integration procedure. The Johansen (1991, 1995) Co-integration involves investigation of the *p*-dimensional vector Autoregressive procedure of k^{th} order:

$$\Delta X_t = \alpha + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \eta_t \qquad (3)$$

where Δ is the first difference lag operator, X_t is a $(p \times 1)$ random vector of time series actors with order of integration equal to *I(1)*, α is a $(p \times 1)$ vector of constant, Γ_i are $(p \times p)$ matrices of parameters η_t is a sequence of zero-mean *p*-dimensional white noise vectors, Π is a $(p \times p)$ matrix of parameters, the rank of which contains information about long-run link between the underlying variables. Vector error-correction model (VECM) expressed in equation reduces to an orthodox vector autoregressive (VAR) model in first differences if the rank *(r)* of Π is zero, while if Π has full rank *p=r*, all elements in X_t are stationary. Further more, $0 < r < p$ suggests the prevalence of *r* co-integrating vectors, such that there exists $(p \times r)$ matrices, δ and β each of the rank *r* such that $\Pi = \delta\beta'$, where the columns of the matrix, δ is adjustment factors and rows of the matrix β is the cointegrating vectors with property that $\beta' X_t$ is stationary even though X_t may comprise of individually *I(1)* process. Test of the hypothesis that the number of Cointegration vectors is at most r(r=1….p) are conducted utilizing the likelihood ration (trace) test for reduced rank in the context of restrictions forced by Cointegration on the unrestricted VAR involving series X_t.

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