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Smallholders' Access to Rural Credit: Evidence from Pakistan

Shehla Amjad* **and SAF Hasnu****

Summary

This paper presents an analysis of smallholders' access to rural credit and the cost of borrowing using survey data from Pakistan. Rural credit in Pakistan comes from formal and various informal sources. The tenure status, family labor, literacy status, off-farm income, value of non-fixed assets and infrastructure quality are found to be the most important variables in determining access to formal credit. On the other hand, the total operated area, family labor, literacy status and off-farm income are found to be the most important factors in determining the credit status of the smallholders from informal sources. The results show that the cost of borrowing from formal sources falls as the size of holding increases. The analysis confirms the importance of informal credit, especially to the smallest of the smallholders and tenant cultivators.

Introduction

This paper consists of an empirical analysis of rural credit markets in Pakistan and attempts to assess a) to what extent is smallholders' access to formal and informal credit limited and what are the factors contributing to this, if any; and b) what do smallholders do to obtain credit, what sources do they utilize and at what cost? The data is based on a survey of smallholders carried out in two villages of district Peshawar. The total number of smallholders interviewed and included in the analysis is 105. For the purpose of the analysis, the government's smallholder category has been further divided into five sub-groups.[1] The division is based on the idea that

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[1] In the Land Reform Ordinance 1972, smallholders are defined as operational holdings up to 12.5 acres in North West Frontier Province and Punjab, 16 acres in Sindh and 32 acres in Baluchistan. Smallholders are all those farmers operating up to 12.5 acres

olders operating up to 5 acres of land have Secondly, the smallholders who are close to the upper limit have a better endowment of resources. The information obtained through the survey interview includes socio-economic characteristics of the household, farm size, income, and tenure and credit transactions. Logistic regression analysis has been used to determine the factors contributing to smallholders' access to rural credit. The paper is organized into nine sections including introduction and conclusions. Section 2 is the literature review and Section 3 describes rural credit markets in Pakistan. Section 4 discusses the socio-economic characteristics of smallholders included in the sample. Section 5 describes the distribution of credit and Section 6, factors determining access to credit. Cost of formal and informal borrowing is discussed in Section 7 and 8 respectively.

2. Literature Review

Rural credit markets consist of formal and various segments of informal sector credit. Economists have long recognized the diversity of such markets and differences in loan contracts (Yadav et al., 1992; Nishbet, 1973; Long, 1968; and Bottomley, 1963). It is well established in the literature that large farmers have better access to formal sources, due to collateral requirements (Heltberg, 1998; Swaminathan, 1991; and Binswanger & Sillers, 1983), moral hazard (Virmani, 1981 and Keeton, 1979), patronage and corruption (Ladman & Tinnermeir, 1981) or high borrowing costs (Sarap, 1990). The majority of rural poor not only have limited access to formal sources but their access to informal sources, other than friends/relatives and landlords, is also highly restricted. Informal credit markets are characterized by the personalized nature of contracts (Tsai, 2004 and Basu, 1997)[2]; inter-linkages (Laurence et al., 1999; Bell & Srinivasan, 1989; Mitra, 1983; and Braveman & Stiglitz, 1982) and heterogeneous borrowers (Basu, 1987 and Braveman & Guasch, 1984) and lenders (Floro & Yotopoulos, 1991 and Ray & Gupta, 1989). The inter-linkage of credit with labor is an important feature of these loan contracts (Yadav et al., 1992; Swaminathan, 1991; and Sarap, 1990) and in many cases informal lenders also select borrowers for quantity rationing (Zeller, 1994). It has been argued that very few landlords advance loans to anyone other

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irrespective of their ownership title to the land operated. The smallholders were sampled according to the actual proportions in the true population.

[2] ñThe rural credit market operates on the basis of personalized relationship, which means that anyone who is prepared to pay the interest rate and meet the collateral requirement, is not likely to receive loan automatically from all lenders.ò [Basu, 1997:268].

997). Other researchers have acknowledged effective in backward areas (Murshid, 1992), can lend money to small borrowers in greater amounts and at lower costs than formal institutions (Ghate, 1992; Adams & Fitchett, 1992; Meyer & Nagarajan, 1991; and Aleem, 1990), enhance trust; and also fill the vacuum left by formal credit (Floro & Yotopoulos, 1991).

3. Rural Credit Markets in Pakistan

Rural credit in Pakistan comes from two sources – formal and informal. The main sources of formal credit are the Zarai Taraqiati Bank Limited (35 percent), the Federal Bank for Cooperatives (4 percent), commercial banks (49 percent) and domestic private banks (12 percent) (Government of Pakistan, 2007:21). The formal lending institutions are regulated by the State Bank of Pakistan that provides counter finance to the Agricultural Development Bank of Pakistan and the Federal Bank for Cooperatives, and agricultural refinance to commercial banks. The informal sector is highly heterogeneous in terms of the relationship between borrowers and lenders and can be grouped into two types. Friends and relatives as a group provide the bulk of credit in rural areas (61 percent of total credit disbursed) while all the rest (landlords, shopkeepers, merchants) provide 30 percent with the share of professional money lenders being 2.12 percent (PIDE/SBP, 1984:164). Informal lenders have limited loan portfolios and operate within narrow areas of influence (SBP, 2003). These formal and informal sources provide credit services that differ from each other in terms of duration and amount of loan, its use, interest rate and transaction costs. In Pakistan, more than 90 percent of smallholders obtain credit from informal sources (Government of Pakistan, 1985).

4. Socio-Economic Characteristics of Sample Smallholders

Descriptive statistics of the sampled smallholders [non-borrowers (28), informal borrowers (36) and formal borrowers (41)] are reported in Table-1.[3] There is variation in the values of socio economic variables but no statistically significant differences are found between informal borrowers and non-borrowers in terms of farm size, tenure status, family size and composition, area devoted to crops and cropping intensity.[4] They only differ significantly in literacy status and off-farm income. There is a higher rate of literacy in the informal borrowers group, while on average non-borrowers have higher off-farm income. This supports the idea that income from other

[3] There are a few smallholders borrowing from both, formal and informal, sources. In the analysis, all of them are included in the group of formal borrowers.
[4] The farmers in the study area were cultivating either sugarcane or wheat and maize.

borrowing both for consumption and & Gunjal, 1998). On average a formal borrower operates a 99 percent larger farm than an informal borrower. The literacy rate is also higher among the formal borrowers. In terms of tenure status, the difference is very high. In the formal borrowers group only 2 percent are tenants, while for informal borrowers, 63 percent are tenants.

Considering all three groups, formal borrowers on average operate on a larger farm size and most of them are owners (98%). The ownership title to land is the single most important determinant of formal credit status, as the percentage of tenants is very high in the informal (63%) and non-borrower (54%) groups. The table shows a higher literacy rate for borrowers - both formal and informal - than non-borrowers. Other considerable differences exist between the three groups in terms of off-farm income. On average all three groups are using the same cash intensive techniques, but both formal and informal borrowers have greater need for credit than non-borrowers due to their low off-farm income. However, due to their tenure status, informal borrowers, unlike formal borrowers, are not able to secure loans from formal sources and are left to borrow from informal sources.

c Characteristics of Sample Smallholders

Variables	Borrower n=28	rmal Borrower n=36	Formal Borrower n=41	Significance (a) Test Statistic (1)	(2)	(3)
Farm Size(acres)	5.51	5.16	6.88	0.45	-2.42***	-2.06***
	(2.88)	(3.33)	(2.8)			
Tenure Status						
Tenant (%)	54	63	2	0.69	57.25***	48.29***
Family Structure						
Size	11.68	11.08	0.51	-0.61	-0.22	
	(4.58)	(4.69)	(5.9)			
Adult (no.)	5.32	6.03	5.54	-0.94	0.74	-0.49
	(2.59)	(3.39)	(2.24)			
Adult Males (no.)	2.82	3.02	2.95	-0.50	0.21	0.47
	(1.47)	(1.81)	(1.27)			
Adult Females (no.)	2.5	3.00	2.59	-1.28	1.18	-0.45
	(1.3)	(1.81)	(1.17)			
Head of the Household						
Age	48.57	45.72	46.59	1.24	0.53	1.01
	(8.39)	(9.66)	(8.77)			
Literate (%)	7	31	51	15.16***	4.88***	33.38***
Off-Farm Income	1861	764	715	2.18**	-0.15	2.26***
(Rs)	(2263)	(1510)	(1406)			
Wheat Area	2.14	1.99	2.09	0.45	-0.33	0.12
(acres)	(1.32)	(1.24)	(1.16)			
Sugarcane Area	3.13	3.24	3.52	0.03	-0.75	-0.91
(acres)	(2.03)	(2.43)	(1.87)			
Cropping Intensity	190	193	173	-0.24	1.72***	1.28
(%)	(50)	(41)	(59)			

(a) For all variables in percentages the Chi-square test has been used, for mean estimates the t-test statistic is presented:

(1) For non-borrowers and informal borrowers

(2) For informal borrowers and formal borrowers

(3) For non-borrowers and formal borrowers

***, **: Significant at 1 & 5 percent level

Figures in parentheses are Standard Deviations

Source: Field Survey

5. Distribution of Formal and Informal Credit

The proportion of formal loans to total borrowing according to the size of holding is given in Table-2. Out of 105 smallholders, 39 percent had borrowed from formal credit institutions. The proportion of smallholders'

rcent in the smallest farm-size group. The n of smallholders borrowing from formal institutions increases as the size of the holding increases. It is highest among the last two groups. Sarap (1990) describes this as the minimal percentage requirement of smallholders met by formal credit sources in India.[5] The table also shows the percentage of formal loans to total loans borrowed. This indicates a high dependence of smallholders on informal credit sources (column 4). For the first group, only about 11 percent of credit used is obtained from formal institutions, with 89 percent obtained from informal sources. The proportion of formal credit to total credit obtained increases with the size of holding up to 7.5 acres, and then falls. Column 7 shows formal credit per acre of the total area. The number tends to increase as the size of land holdings increases and then falls for the largest farm-size operators. This corresponds with Yadav et al's (1992) findings that formal sector borrowing per unit of cultivated area initially increases and then decreases with farm size in Nepal.

Table-2: Proportion of Formal Loans to Total Loan Borrowed

Size of Holding Area	Percentage of House-Holds in the Group	Percentage of Farmers Borrowing Formal Loan	Percentage of Formal Loan to Total Loan Borrowed	Percentage Received by Group to Total F.C.	Percentage of Area Owned to Total Area	Credit per Acre of Total Area (in Rs.)
1	2	3	4	5	6	7
Up to 2.50	15.24	18.75	10.69	2.76	4.78	470.59
2.51–5.00	33.33	31.43	46.05	14.47	21.82	541.44
5.01–7.50	24.76	42.31	76.98	29.63	27.73	872.46
7.51–10.00	13.33	64.29	42.42	29.72	19.16	1237.70
10.01–12.50	13.33	50.00	52.42	23.43	26.05	734.57
Total	100.00	39.05	47.52	100.00	100.00	816.72

Source: Field Survey

Column 6 gives the proportion of area owned to the total area. It shows that inequality in the distribution of formal credit mirrors the inequality in the ownership of land. The very small and marginal smallholders had less access to formal credit institutions than the relatively

[5] ñOf the total amount only 1.19 percent was borrowed by small farmers (operating up to 2.5 acres) while their share in total sample was 24 percent. On the contrary large farmers (more than 10 acres) constitute 12 percent of the total sample, but getting 44.38 percent of the loans,ò [Sarap, 1990:287].

Khan's (1984) findings that in 1979-80 the farm holding was 68 percent while the proportion of borrowers in this group was about 18 percent.

The proportion of formal credit received to total formal credit for each group is given in column 5. The values indicate very unequal access for different farm-size groups. It shows greater access for the operators of large farms than smaller farms. Of the total amount borrowed, only 2.76 percent had been borrowed by the farm households operating up to 2.5 acres of land, while this size group accounts for 15.24 percent of the total sample of farm households. The share increases for the second smallest farm-size group to 14.47 percent with 33.33 percent of farm households in that group. In absolute numbers the share of the third group of mid-size smallholders is also quite large (29.7 percent). In relative terms, this group is obtaining less credit as compared to the last two groups. As a proportion the third group in the total sample of farm households is 24.76, while for the two largest groups this proportion is 13.33 each, and they are getting 29.72 and 23.43 percent of the total formal loans respectively.

The proportion of informal loans to the total loans borrowed, according to size of holdings is given in Table-3. Of 105 sample smallholders, 34.28 percent had borrowed from informal credit sources in the reference year. The percentage of borrowing is highest among the smallest land holders (62.5 percent), and lowest among the mid-size small holders of 5-7.5 acres (15.39 percent). The conditions are exactly opposite for borrowing from formal credit sources, where the smallest farm size group has the lowest value and the group of mid-size smallholders has the highest value. This suggests that there is an identifiable gap in formal credit allocation that is filled by informal credit. The table shows a decreasing trend in the percentage of borrowers from informal sources as the size of holding increases. The reason can be that larger farmers have a better chance of getting loans from formal sources. The amount borrowed from informal credit sources does not depend on the acreage. Thus credit per acre is found to be the highest for the smallest landholder, whereas, it is lowest for the mid-size farm size group, showing no clear trend with the size of holding.

mal Loans to Total Loan Borrowed

Holding Area	e of Farmers Borrowing Informal Loan	of Informal Loan to Total Loan Borrowed	Credit per Acre of Total Area (in Rs.)	Average Amount of Loan (in Rs.)	Number of Loans Received by the Group to Total Informal Loans	Amount of Credit Received by the Group to Total Informal Loans
1	2	3	4	5	6	7
Up to 2.50	62.50	89.31	3917.43	9750	29.27	20.85
2.51–5.00	37.14	53.95	638.96	5740	36.59	15.34
5.01–7.50	15.39	23.02	274.83	11250	9.76	8.02
7.51–10.00	35.71	57.58	1702.66	41000	12.20	36.54
10.01–12.50	28.57	47.58	653.06	21600	12.20	19.25
Total	34.28	52.48	1012.98	13685	100.00	100.00

Source: Field Survey

Similarly the average amount of informal loans shows no clear trend. However, it is very low for the smallholders operating up to five acres of land compared with those operating more than five acres. The percentage of informal borrowing to the total loans borrowed is also very unequal across different farm-size groups. Of the total amount of loans borrowed, 52.48 percent is borrowed from informal sources. The percentage is highest among the operators of the smallest farms (89.31), a figure that is close to the 90 percent estimated for Pakistan (Government of Pakistan, 1985). However, for other groups of sample smallholders, the percentage varies between 23 and 58 percent, which is quite low as compared to the overall estimates for Pakistan.

The percentage distribution of amount and number of informal loans is also given in Table-3 (column 6 & 7). The number of loans received by each group (as a percentage of total informal loans) shows that more than 65 percent of the loans are obtained by the smallholders operating up to 5 acres of land. However, when the ***loan amount*** received by the smallholders operating up to 5 acres of land to the total informal credit is considered, the conditions are opposite. Only about one-third of the total amount borrowed from informal sources is going to these smallholders. The smallholders operating more than 5 acres are receiving 35 percent of informal loans in number but their share in the total amount lent is 65

al sources also smallholders operating more share of total lending.[6]

Two types of access ratios are calculated as follows:

$$\text{Ratio 1} = \frac{\text{Proportion of loans (\#) received by the group to total loans}}{\text{Proportion of smallholders in that group to the total sample}}$$

$$\text{Ratio 2} = \frac{\text{Proportion of credit (amount) received by group to total credit}}{\text{Proportion of area operated by the group to total area operated}}$$

For these ratios, any number greater than one shows greater than average access, any number less than one shows less than average access, and one means equal access. The interpretation of these ratios is different for formal and informal credit sources, as different factors contribute to the credit status of smallholders in these two cases. For formal credit sources, the ratios mainly show that access depends on smallholders' willingness to apply for credit based on his needs mainly for production purposes, plus lenders' decisions to advance credit based on certain characteristics of the potential borrower. In the case of informal credit, the need can be for production or consumption, and the decision to lend depends on the personalised nature of the contract, as informal credit is mostly provided by friends and relatives. If informal credit is considered to be used for bridging the gap between the need and supply of credit from formal institutions, then in a way these ratios explain the extent of credit needs satisfied by informal credit sources for the different farm-size groups.[7]

Access ratios are given in Table-4. For formal credit the value of Ratio 1 is 0.48 for the smallest farm size group, and it increases as the size of holding increases. This ratio reaches a maximum of 1.65 for the second largest farm size group, showing greater access.[8] In the same way Ratio 2 is

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[6] There is a common saying in local language that, ñeven friends and relatives give loans to those who have a chance of good harvest.ò Zeller (1994:1904) finds that the informal lenderôs decision to approve a loan request is based on the wealth of the applicantôs household.

[7] This can be called the residual function of informal credit. Informal credit fills the large vacuum arising due to unfulfilled demand of less qualified loans by the formal sector. Similar observations have been made by Floro & Yotopoulos (1991) in case of the Philippines.

[8] Based on secondary data, Malik et al (1989) calculated Ratio 1 for Pakistan as well as for all four provinces. They find negligible access to formal sources for smallholders in all the cases.

group and increases as the size of holding e second largest farm size group.

Table-4: Access Ratios

Size of Holding (Area)	Ratio 1		Ratio 2	
	Formal	Informal	Formal	Informal
Up to 2.50	0.48	1.92	0.58	4.56
2.51–5.00	0.80	1.10	0.66	0.70
5.01–7.50	1.08	0.39	1.07	0.29
7.51–10.00	1.65	0.91	1.52	1.86
10.01–12.50	1.28	0.91	0.90	0.74

Source: Field Survey

It is interesting to note that for farms above 5 acres the ratio is greater than one, while for the rest it is less than one. It can be assumed that somewhere in between 5 and 7.5 acre this is equal to one. If we divide the sample smallholders in two groups, one with smallholders operating up to 5 acres of land (group A) and the other with operational holdings greater than five acres (group B), the table shows that group A has less than average access to formal credit while group B has more than average access to these sources. Therefore, due to farmers' inaccessibility to formal credit they have to borrow from informal sources.

For informal credit, Ratio 1 is highest for the smallest farm operators and lowest for the mid-size smallholders of 5-7.5 acres. However, the main difference is that for smallholders operating up to 5 acres of land, this ratio is greater than one while for the rest it is less than one. In the same way Ratio 2 is highest for the smallest farm-sizes and lowest for the group of mid-size smallholders. This implies that credit needs of the smallest smallholders are mainly satisfied by informal sources (Tsai, 2004)[9].

6. Determinants of Access to Rural Credit

The use or non-use of credit can be explained with the help of smallholders' characteristics. It is hypothesized that borrowing depends on

[9] Tsai (2004) concludes that the enduring popularity of informal credit is due to: a) formal sources being unable to meet demand for grassroots credit (availability and access); b) informal sources possessing better knowledge about local actors and conditions (comparative advantage); and c) formal and informal markets serving different segments of rural society.

us[10], family labor, literacy status and age of of non-fixed assets, off-farm income, and a village dummy variable. These characteristics are important in two ways, a) they can influence the household demand for credit; and b) potential lenders are likely to base their assessment of borrower's credit worthiness on these characteristics. It is very difficult to completely separate the variables affecting demand or access because at both stages, decision making is based on almost similar considerations. Therefore, certain variables included in this regression are more related to smallholders' demand for rather than access to credit, including age, value of non-fixed assets and off-farm income.

For the logistic regression equations estimated here, the value of the dummy dependent variable equals one if a smallholder has borrowed in the reference year and equals zero if it has not. Independent variables include family labor, which is expected to have a positive effect. In the same way, total area operated is expected to be positively related to the access to credit. Formal credit is advanced on the basis of land ownership and generally bank officers expect that a large land holding will yield a large output, enabling the loan to be repaid by the borrower quite easily. Literacy status can also influence farmers' access to formal credit institutions, and this effect is expected to be positive, because literate farmers are assumed to have better technical know how and information about the market and other facilities provided by the government. Secondly, they have a better understanding of bureaucratic procedures involved in the application, acquisition and repayment of loans.

On the demand side, age of the head of the household is expected to have a negative effect, as comparatively young farmers are expected to be more active in their farm activities. High off-farm income is assumed to reduce demand for credit and can be used to purchase cash inputs for production and/or even out consumption at times of need. Similarly, the value of non-fixed assets (i.e. livestock) is expected to have a negative effect. The ownership of a bullock will reduce the demand for credit needed for a tractor, while cows and buffaloes are sources of additional cash income. The regional dummy equals one if the farm household belongs to a village with better infrastructure facilities and a commercial bank branch.

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[10] Tenure status is expected to be negatively related to credit, as formal lenders insist on collateral, particularly ownership rights to land. Thus, tenants have less chance of getting credit than owner cultivators. Tenure status is excluded from the analysis because out of 41 borrowers only one happens to be a tenant. Due to this strong effect other variables in the equation were giving unexpectedly large coefficients.

ccess: Dummy Dependent Variable 1, if a Borrower; 0, Otherwise

Explanatory Variables	Estimated-Coefficient (n = 105	Wald Statistic	Exponential Values
Total Operated Area	0.2111	4.68**	1.2351
Family Labor	0.2299	0.91	1.2585
Lit-Status (1=Literate)	2.9885	11.40***	19.8564
Age	0.0147	0.25	1.0148
Off-Farm Income	0.0003	2.24	0.9997
Non-Fixed Assets	-0.0005	5.24**	1.0000
Village (1=Better)	2.8267	10.1***	16.8888
Intercept	-4.5213	5.94***	-------
Log Likely-hood Ratio	96.049	-------	-------
Model Chi-Square	44.433**	-------	-------
Degree of Freedom	7	-------	-------
Goodness-of-Fit	94.098	-------	-------
% of Correct Predictions			
• Overall	76.19	-------	-------
• Borrowers	63.41	-------	-------

***, **, *: Significant at 1, 5 and 10 percent, respectively.

The results of the logistic regression are presented in Table-5 for all borrowers. As shown in the table, all variables, except age head of the household, have the expected relationship with credit. Total operated area has a positive and significant effect, indicating that an increase of one unit in operated area increases the chance of borrowing by a factor of 1.235 (exponential value). Literacy status can increase the probability of being a borrower by a factor of 20. Similarly, the chances of borrowing for the smallholders living in a village with better infrastructure increase by a factor of 1.17. Family labor, age head of the household, off-farm income and value of non-fixed assets have almost one to one effect on the probability of being a borrower.[11]

Table-6 presents the results of the logistic regressions for formal and informal borrowers. For formal borrowers, all variables have the expected relationship with credit. Literacy status and the value of non-fixed assets are

[11] The exponential values of these variables can be raised by 1000 to account for a change of Rs. 1000 in the value of these variables.

1, with all the rest at the 5 percent level. ect. The chance of formal borrowing can significantly increase by a factor of 3.34, if the family has one additional male member. The coefficient for operated area is found to be positive but statistically insignificant, indicating that increase of one unit in operated area increases the chance of formal borrowing by a factor of 1.17. In the case of formal credit, literacy status of the head of the household has the most pronounced effect, indicating that being literate can increase the probability of being a formal borrower by a factor of about 65. Similarly, for farmers living in a village with better infrastructure facilities, the chance of being a borrower increases by a factor of about 12.75.[12] The age of the head of the household, non-fixed assets and off-farm income have a negative relationship with formal credit. One unit change in off-farm income and value of non-fixed assets can slightly reduce the probability of being a formal borrower, as exponential values are close to one.

Table-6: Determinants of Access: Dummy Dependent Variable 1, if Smallholder is a Formal OR Informal Borrower; 0, Otherwise

Explanatory Variables	Est-Coeffs (n = 69	Wald Statistic	Exponential Values	Est-Coeffs (n = 69	Wald Statistic	Exponential Values
Total Operated Area	0.1533	0.779	1.1656	-0.2388	2.747*	1.2732
Family Labor	1.2063	4.951**	3.3412	0.6024	3.747**	1.8344
Lit-Status (1=Literate)	4.1768	11.07***	65.1547	1.7728	3.928**	5.8873
Age	-0.0207	0.175	0.9795	-0.0442	1.442	0.9275
Off-Farm Income	-0.0007	4.317**	0.9993	-0.0005	4.144**	0.9995
Non-Fixed Assets	-0.0001	8.200***	0.9999	-0.0004	1.823	0.9996
Village (1=Better)	2.5456	5.888**	12.7515	-------	-------	-------
Intercept	-2.3702	0.796	-------	3.07	2.376	-------
Log Likely-hood Ratio	47.485**	-------	-------	69.838***	-------	-------
Model Chi-Square	45.706***	-------	-------	17.883***	-------	-------
Degree of Freedom	7	-------	-------	6	-------	-------
Goodness-of-Fit	46.102***	-------	-------	64.103***	-------	-------
% of Correct Predictions						
• Overall	81.16	-------	-------	68.75	-------	-------
• Borrowers	85.37	-------	-------	75.00	-------	-------

[12] Murshid (1992) shows that informal sources are important in backward areas making up to 98 percent of total loans advanced whereas their share is 67 percent in developed areas.

10 percent, respectively.

The logistic regression results for informal borrowing are also reported in Table-6. The dummy dependent variable takes a value of one if the smallholder has borrowed from informal sources, and zero otherwise. The total operated area, age of head of the household, value of non-fixed assets and off-farm income, all have a negative relationship with informal borrowing. Only family labor and literacy status are positively related to informal borrowing. The results indicate that the larger the operational holdings, the greater is the chance of getting loans from formal sources and lower the dependence on informal sources, especially when smallholder has ownership title to land. Therefore, informal borrowing decreases as the size of holding increases. A unit increase in the total operated area will reduce the chance of informal borrowing by a factor of 1.27. However, smallholders with higher values of off-farm income or non-fixed assets can satisfy their cash needs from their own resources and are less inclined to borrow, not only from informal sources but also from formal credit sources. An increase in the values of off-farm income and non-fixed assets will reduce the chance of borrowing only slightly since the odds-ratio is close to one.[13]

The literacy status and age have the same impact on formal and informal borrowing. For a literate smallholder, the chance of informal borrowing increases by a factor of 5.89. For age, there can be two possible explanations for the negative relationship, a) if borrowing is for production, comparatively young smallholders are more active in their farm activities; and b) if it is for consumption, at times of need young smallholders have less in the form of accumulated wealth, thus they are more dependent on borrowing. Family labor has a positive effect on borrowing. On the demand side, there are few off-farm income opportunities in the rural areas; thus for large households, more inputs are required for effective utilization of available labor. If the household is not able to get credit from formal sources, informal sources are utilized. On the supply side, whether the loan is borrowed from friends and relatives or a landlord, more workers in the

[13] Nisbet (1973:3) compares formal and informal credit markets, ñOne the basis of five characteristics (farm size, tenure type, education, mechanisation and gross output), over 60 percent of institutional borrowers are identified as land owners, controlling more than five hectares of land, having more than seven years of education, working farms that utilise modern machinery and equipment and producing a gross output of more than $650 a year.... [while] over 60 percent of informal borrowers are identified as landless farmers, operating farms of less than five hectares, having less than six years of education, exploiting their farms with only hand tools... and showing a gross output less than $650 a year.ò

e of getting a loan. From the lender's rning hands and thus a better chance of receiving repayment. For landlords, this means greater availability of labor at times of need. Another possible explanation can be that large families have more members, and as informal borrowing is mainly for consumption, large families require more consumption credit (Yadav et al., 1992).[14] Therefore, an additional family member will increase the probability of borrowing by a factor of 1.83.

On the whole the regression results are significant with a high prediction rate, and high values for log likelihood ratio and goodness-of-fit statistics. We can also reject the joint hypothesis that all coefficients statistically equal to zero. Considering the influence on smallholders' access to formal credit, family labor, literacy status, off-farm income, value of non-fixed assets and village are found to be the important variables. The total operated area, family labor, off-farm income and literacy status are found to be the important factors in determining the credit status of the smallholder regarding informal sources. Whereas in case of all borrowers, literacy status, operating area, value of non fixed assets and village are found to be important variables.

7. Cost of Formal Credit

In Pakistan, a potential borrower is required to submit a formal application for a loan.[15] According to regulations all farmers, owners or tenants (with large or small farms) can apply for formal credit. The guarantee of two persons is required (SBP, 2003). In most cases the farmer will be able to obtain the loan, but it is a lengthy procedure, starting from the application stage, to the sanctioning and receipt of funds. The effective cost of borrowing from the point of view of borrowers is the real cost consisting of interest plus other transaction charges.[16] The opportunity time

[14] Yadav et al (1992) find family size as the main determinant for informal credit and farm size and irrigation as the main determinants for formal credit.

[15] The application should be well supported by the relevant papers, including a certificate from the land revenue department about smallholdersô title to the operating land, total area operated and the number of parcels. The applicant has to supply a photograph and photocopies of a number of other relevant documents. A number of visits to the bank and land revenue office are required to get the relevant documents and in addition to normal charges, sometimes special payments are made for work to be done quickly.

[16] Transaction costs include application fee; cost of photograph, stamps, paper and photocopying; cost of obtaining copy of record from land revenue department; visits to the bank and transport charges per visit; number of visits to the land revenue office and

culating transaction costs.[17] After the loan
v days to get the loan.[18]

The distribution of formal credit according to time taken and size of holding is given in Table-7. There are variations but no statistically significant difference has been found in the time taken to get the loan. However, days taken to get the loan sanctioned, as well as the days between sanction and receipt, show a gradual decrease as the size of holding increases. The gap between the smallest and largest farm size groups varies between 4 to 8 days. However, the Chi-Square test found this difference to be statistically insignificant.

Table-7: Time Taken from Date of Application to Receipt of Credit

Size of Holding (Area)	Days Taken to Get Loan Sanctioned	Days Between Sanction and Receipt	Total Days from Application to Getting Loan
Up to 2.50	30.00	21.67	51.67
2.51–5.00	27.27	21.82	49.09
5.01–7.50	28.64	17.73	46.36
7.51–10.00	29.44	16.11	45.56
10.01–12.50	25.71	17.43	43.14
Unweighted Average	28.05	18.71	46.76
Chi-Square Statistic	0.48	1.45	0.92

Source: Field Survey

Transaction costs according to the size of holding are presented in Table-8. The average transaction cost increases as the size of holding increases. However, as a proportion of the amount of loan it falls as size of the land holding increases. For the first two groups (the two smallest farm

transport charges per visit; and cost of food and special payments to officials of the bank or revenue department.

[17] It is considered as equivalent to one day's wage labor and calculated at the wage rate prevailing at the time when the smallholder was applying, acquiring and repaying the loan. If the bank's branch is situated in the village, then visiting the bank can be a matter of hours only, but if a smallholder has to travel or to wait for his turn then the whole day is required to do the job. The numbers of visits to the bank vary between two and four. The average visits to the revenue department also show a similar pattern.

[18] As the loan is given in kind, the smallholders try to get their choice variety of fertilizer rather than taking lower quality. For this they have to visit the fertilizer depot many times.

ile for the last three groups it is about 4.5
's borrowing costs as one of the main
determinants of smallholders' inaccessibility to formal credit.

Table-8: Cost of Borrowing from Formal Credit Institutions

Size of Holding (Areas)	Average Amount of Loan (Rs.)	Interest Charges Per Year (Rs.)	Average Transaction Cost (Rs.)	Average Cost of Loan (Rs.)	Average Transaction Cost as Percentage of Average Amount of Loan	Total Cost as %age of Average Amount of Loan
Up to 2.50	4666.67	426.67	538.33	965.00	11.54	20.68
2.51–5.00	6681.82	655.45	592.73	1195.45	8.87	17.89
5.01–7.50	13681.82	1734.55	650.00	2004.55	4.75	14.65
7.51–10.00	16777.78	1741.11	664.44	2272.22	3.96	13.54
10.01–12.50	17000.00	1940.00	737.14	2437.14	4.34	14.34
Total	12390.24	1385.85	644.51	1844.02	5.20	14.88

Source: Field Survey

The effective rate of interest (the nominal rate of interest plus the transaction cost) is about 21 percent for the smallest landholders group and then gradually decreases as the size of the farm increases, reaching about 14 percent for the largest farm-size group. The nominal interest charged by formal credit institutions was 8 percent in the reference year. The effective rate of interest paid by the smallholders is more than double the nominal rate, the rate being highest for the smallest of the smallholders.

8. Cost of Informal Credit

Usury is forbidden in Islam. In an Islamic society like Pakistan, it is very difficult to get information about the rate of interest paid on informal loans. People avoid discussing interest based lending and 'Sood Khore'[19] is a common abuse.[20] Before independence, the majority of professional money lenders were Hindus and the rates charged by them used to be very high (Government of Pakistan, 1957). After independence, the Hindus migrated to India and there was a large gap to be filled by other sources. One cannot

[19] One who takes interest on the amount lent.
[20] Yazdani (2005) stated that small farmers prefer taking out loans from Islamic Credit System in Iran due to risk sharing and religious acceptability.

is not taking place in Pakistan.[21] However, ng place openly, and wherever it is done, professional money lenders charge very high interest rates.[22]

There are two main sources of informal borrowing in the study area, namely friends and relatives, and landlords. No interest is charged on the loans from friends and relatives as these loans are based on good will and reciprocity of transactions. However, the borrowers admit that since they are obliged to lenders, they cannot oppose them in family and community decisions. For small tenant households at the time of need friends and relatives may also be going through the same financial difficulties. Thus the only way left is to borrow from someone who is financially well-off, knows the borrower and can trust him for money, such as the landlord. In our sample, all landlords were providing credit to their own tenants, working under sharecropping tenancy. Out of 9 tenants borrowing from landlords, 8 have operational holdings up to 5 acres. Thus ownership status and operated area can be the most important reasons for interlinked borrowing.[23]

The relationship between informal borrowing and tenure status is found to be very strong. As presented in Table-9, out of 105 sample borrowers 42 are tenants and only one of them is getting a loan from formal credit sources whereas the total number of borrowers from formal sources is 41. Thus only 2 percent of tenants are borrowing from formal sources and out of the total formal borrowers only 2 percent happen to be tenants. The percentage of tenants is highest in the smallest farm size group, and reduces as the size of holding increases. In the largest farm size group, most of the tenants have rented-in the land while in other four farm size groups the majority of tenants are sharecroppers. Considering tenants as a percentage of informal borrowers, in total 72 percent of informal borrowers are tenants while in groups 3 and 5 (the mid-size and largest

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[21] ñAmong the Kenya samples, the reported use of moneylender funds was very low which appeared to be a reflection of the stigmatized nature of money lending and the absence of moneylenders in particular areas (the sensitive nature of money lending may well imply that more people had actually used this form of finance than were willing to admit to it).ò [Buckley, 1997:1084].

[22] It was found during the field survey that there is a professional money lender, who lives in the tribal area and charges 200 percent interest on loans. Villagers, who are really desperate, use this source. However, none of the respondents admitted that they ever used this source of credit.

[23] Various types of interlinked credit transactions have been discussed in the literature. Firstly, linking credit with input, output or both, and secondly linking credit with labor services, tenancy or both. The former can be the case of a shopkeeper lender or a landlord lender, while latter is the case when only a landlord can be a lender.

mal borrowers are tenants. In other groups
92 percent. Out of 36 informal borrowers
only 9 borrow from landlords (25 percent). In total, there are 26 informal borrowers who are tenants, and out of these 35 percent borrow from landlords, and more than 80 percent of them operate land up to 5 acres. This shows that farmers who do not own land and operate small holdings are more inclined to rely on the informal credit sources, particularly credit from landlords.

Table-9: Informal Credit and Tenure Status

Size of Holding (Areas)	Total Tenants in the Sample		Total Informal Borrowers		Tenant/Informal Borrowers		Tenants Borrowing from Landlords	
	No.	%	No.	%	No.	%	No.	%
Up to 2.50	8	50.00	10	62.50	5	50.00	4	40.00
2.51–5.00	17	48.57	13	37.14	12	92.00	4	31.77
5.01–7.50	10	38.46	4	15.39	4	100.00	1	25.00
7.51–10.00	1	7.14	5	35.71	1	20.00	-	---
10.01–12.50	6	42.86	4	28.57	4	100.00	-	---
Total	42	40.00	36	34.28	26	72.00	9	25.00

Source: Field Survey

The borrowing from landlords is for two purposes, production and consumption. In the case of consumption it is for social and religious ceremonies or emergencies.[24] There is no definite date for the loan to be repaid but the most probable time is that of harvest, when in almost all the cases repayment is done in terms of output. The borrowing for production purposes is for inputs, mainly fertilizers. In the sharecropping arrangement, fertilizer expenditure is equally divided between a tenant and a landlord. However in most of the cases, the tenant has no cash to purchase fertilizer. Therefore, the landlord provides cash for this input and at the time of harvest before dividing the output, a pre-determined amount is given to the landlord as repayment for fertilizer.

There are only three cases in the sample when tenants have been borrowing from landlords for production purposes. In the first case the landlord borrowed from the bank and provided fertilizer to the tenant as a

[24] In Pathan families the main expenditure is incurred on the sonôs marriage because he/his family has to give clothes and gold jewellery to the bride according to demands of her family. In certain tribes some cash payment is also made to the brideôs family.

was provided to the tenant as cash from the third case loan was provided in the form of fertilizer by the landlord. In all three cases the fertilizer was used for sugarcane production and it was agreed that one trolley of sugarcane will be given to the landlord as repayment prior to the distribution of output. The expenditure on fertilizer amounts to (Rs 2000-3000), less than half the price of one trolley of sugarcane (Rs 5500-6000). Thus in a way the tenants were paying 100 percent more than what they received as a loan.

Thus, the main advantage that landlords have as lenders is repayment in terms of produce.[25] In the study area, both landlords and tenants sell their produce to the sugar mill. Secondly, landlords more willingly provide credit when a tenant asks for a production loan than a consumption loan.[26] This results in higher production and high crop income for the landlord, as total production is equally divided between the landlord and tenant under sharecropping tenancy. Thirdly, whether the loan is for production or consumption, landlords feel important if tenants or any other villager ask them for loan. If their own tenant asks someone else for a loan they may take it personally.[27] Fourthly, landlords also take part in politics and it is good for them to have good relations with tenants. In this way their votes are secured in the village. Basu (1997) has defined this as 'political power' which landlords as a group enjoy over the entire village community. Another advantage that landlords have from extending credit is free labor, both on-farm and domestic. There is no direct agreement for labor services but landlords can ask tenants any time for work, even at the times they are fully occupied with their own work.[28] It reduces the costs of hiring labor for landlords at peak times. The tenants' children often work full time as servants for landlords without any cash payments, only food and clothing. Their future well being is considered by their parents as the landlord's responsibility.

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[25] There is a difference between output-linked credit and the conditions observed in the study area. Output-linked loans are when farmers settle their loan obligations in terms of the sale of output and shopkeepers/traders are the principle lenders.

[26] According to a landlord interviewed, õThey [tenants] have no interest in farming. They never asked for money for seeds or fertilizer, every time they have a new excuse for borrowing, like my child is ill, some one in the family is getting married, etc.ô

[27] This reveals two interesting phenomena: a) borrowersô access to loans is tied to one particular lender and b) borrowers cannot shop around for loans (Basu, 1997).

[28] Some of the tenant smallholders argued that free labor has nothing to do with borrowing. According to them, ó...if we do not have any extra benefit [credit] even then we can not refuse to work for the landlord. How can we? We are tilling his landô

This paper examined the different factors limiting smallholders' access to rural credit. The survey data from two villages of Peshawar district has been used to identify and analyze these factors. The analysis shows that formal borrowers have significantly higher values than informal and non-borrowers for all socio-economic variables, while informal and non-borrowers can be treated as a homogeneous group with their only major difference being off-farm income. Considering the access ratios or proportion of credit received by the group to the total formal credit, the results show that smallest smallholders have less than average access to formal credit in the study area.

The main factors explaining inaccessibility to formal credit are found to be the total operated area, literacy status, value of non-fixed assets and infrastructure quality in the area. In terms of borrowing costs, no significant difference has been found in time taken to obtain the loan. The effective rate of interest and the average transaction cost as percentage of average amount of loan decreases as the size of holdings increases. Thus, the smallest smallholders have to pay higher costs to obtain formal credit. The total operated area, family labor, literacy status and off-farm income are found to be significantly related to the determination of credit status for informal borrowers. The single most important variable determining credit status is found to be the tenure status, as 98 percent of sample formal borrowers are owner-cultivators and 72 percent of sample informal borrowers are tenants.

Informal credit is found to be used for both consumption and production. The findings show a higher dependence of the smallest smallholders on informal sources that falls as the size of holding increases. However, the average loan amount borrowed from informal sources increases as the size of holding increases. It suggests that informal lenders also select borrowers for quantity rationing. There is no explicit cost of borrowing from informal sources, as no interest is charged. However, for friends and relatives borrowers have to sacrifice an independent say in the family and community matters and for landlords repayment includes free labor and rough estimation of repayment in kind.

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The Incidence of Government Expenditures on Education and Health: Microeconomic Evidence from Pakistan

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Abstract

This paper has analyzed the incidence of government expenditures on health and education by using the benefit incidence approach. Recent household level data from the Pakistan Standards of Living Measures (PSLM) has been used to calculate the incidence for Pakistan overall, and at provincial and regional levels, of different education and health services. GINI and concentration coefficients have been used to measure the benefit inequalities of public expenditure. The results demonstrate that education expenditures are progressive in overall Pakistan. The progressiveness hypothesis regarding health expenditure is accepted partially, as the expenditure is progressive for Pakistan overall, but regressive at regional and provincial level of services. Efforts should be directed towards the horizontal and vertical equity in the allocation of resources both at the provincial and regional levels, and greater targeting of rural and low-income groups can make the expenditure programs more effective and result oriented.

Key Words: Benefit Incidence, Health, Education, and Pakistan

Introduction and Background

A vast body of literature exists on the incidence of government expenditures. Most of the studies have used the benefit incidence approach on household data. Findings demonstrate that public expenditures are either progressive or regressive and the share of different income groups varies depending on the distribution of the benefits of the public expenditures across region, caste, religions, gender etc, [see e.g. Christian (2002), Rasmus

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Demery and Verghis (1994), Jorge (2001), vid and Stephen (2000), Gupta *et al.* (1998, 2002), Hug *et al.* (1998), Lamiraud *et al.* (2005), SPDC (2004), ESCAP (2003), Norman (1985), Castro *et al.* (2000), Hamid *et al.* (2003), Sakellariou and Harry (2004), Shahin (1999) etc]. The studies which demonstrate progressiveness such as Rasmus *et al.* (2001) focus on the incidence of the public expenditure on education and health (Mozambique data) and resulted in the poorest quintile of income groups receiving 14 percent of total education spending; the poorest half receives 36 percent, and the richest quintile receives 33 percent. Hyun (2006) by using household data from Thailand concluded that government subsidies (in-kind transfer income) benefit the poor and can reduce poverty. With a data set from Ecuador, Younger (1999) used a combination of benefit and behavioral approaches and found that public spending improves health and education indicators in developing countries. Cross country studies such as Gupta et al. (2002) used 56 data sets and showed that the increase in public expenditures on health and education are associated with improvement in both access to and enrollment in schools, and reduce the mortality rates in infants and children.

Other studies that determine the regressiveness of the incidence of public expenditure such as Norman (1985) concluded that many government expenditures on education and health benefit upper income more than the lower income groups. Castro-Leal *et al.* (2000) examined public spending on curative care in several African countries and found that spending favored mostly the better off rather than the poor. Hamid *et al.* (2003) has also shown evidence of substantial cross-country heterogeneity. The subsidies in education can be progressive or regressive; normally these subsidies are progressive at the lower levels of education and regressive at higher levels. Demery and Verghis (1994), using a data set from Kenya, concluded that primary education spending was strongly progressive in absolute as well as in relative terms while secondary and university education spending were regressive in absolute terms, and weakly progressive relative to. In-kind transfers tend to be progressive unless there are serious targeting problems.

Justification of government expenditures on education based on the social rate of return e.g. Pascharropolous (1994) and World Bank (1995) found that the return is highest on primary education followed by secondary and tertiary education. At the same time, evidence suggests that spending on tertiary education in many countries is higher than primary and secondary education. Lanjouw and Martin (1999) by using data from rural India have argued that marginal spending affects the poor more than

programs are expanded or reduced the ds to change. Shahin (1999) showed that inequity in benefits from education spending in Côte d'Ivoire is greater amongst the female population than in the male population – although this is not as true for health in Guinea. There exists a strong negative relation between income and expenditure shares. Bjo¨rn and Li (2004) in China based on data from households in 18 provinces in 1988 and in 1995 also proved this same result.

A few points deserve to be discussed. First, the impact of *the level* of public expenditures on human capabilities is a debated point, because not all studies have found an empirical link between the two. The link between successfully addressing poverty issues and spending is not primarily a function of the percent of GDP that is devoted to total spending on health and education, but depends foremost on the intra-sectoral allocation to health and education spending. Evidence demonstrates that countries with high shares of education spending devoted to primary and secondary levels recorded higher persistence rates through grade four and higher primary and secondary enrolment rates. Infant and child mortality rates are lowest in countries with high shares of health spending devoted to primary (preventive) care. Second, policy makers must confront the nature and magnitude of the fiscal incidence. The policy choices require information about which groups are likely to pay for and which groups are more likely to benefit from expenditures. Policy makers have many questions about how to reduce the burden of taxation for lower income groups and about how to increase the effectiveness of public expenditures. How can public spending be targeted in order to improve the conditions of the poor? Hence, incidence analysis provides some critical information to help policy makers achieve a more equitable distribution of income and improve effectiveness of public policy.

The literature is substantial in understanding the question of the incidence of public expenditure across the developing as well as developed countries. However, largely, the available literature has been conducted on old data sets of household surveys, and the studies are not updated or done afresh. Second, there is a lack of comparisons of incidence across countries on one hand and incomparability of cross country results on the other hand. Third, the impact on different groups or populations, or gender- or region-wise impact of incidence are not taken into consideration, factors emphasized by Seldon and Wasylenko (1992). Fourth, literature on the

...liture and its distribution in Pakistan[29] is ...2003) and Hussain *et al.* (2003) have been conducted in this context, but both studies suffer from a number of problems. For Example, Sabir (2003) has used a three-step methodology on the data of HIES 2001-02. Only for education expenditure does the study segregate subsidies gender- and region-wise and concluded that the government subsidies directed toward primary education are pro-poor in all four provinces. However, females are more disadvantaged in terms of access to primary education. Government subsidies directed towards higher education are poorly targeted and the poorest income group receives less than the richest income group and indeed favor those who are better off. The study also falls short of classifying the analysis based on the rural/urban dimension. The other study, Hussain *et al.* (2003), has used secondary data sources, taking the averages of the expenditures for the incidence analysis. The study has used the Representation Index and GINI coefficient technique for the allocation of resources to the education sector district-wise and inequalities among districts in the allocation of the resources to the education sector. They concluded that there exist no disparities between the districts' allocations of funds to education. This study has not used GINI and concentration coefficients to measure the income inequalities and was limited to allocation of education expenditures only.

The literature discussed above is not very comprehensive in dealing with the question in the Pakistani context for a number of reasons; both studies were conducted on old data sets by taking averages of secondary sources, second, both studies only take into account education for their analysis and used different instruments. Third, health expenditure is not included in their set of variables; fourth, Hussain *et al.* (2003) falls short in analyzing the inequalities of distributions of expenditure on income or using GINI and concentration coefficients to determine the progressiveness or regressiveness of expenditures.

This aim of this study is to analyze the incidence of public expenditures in Pakistan on education and health by using the latest household survey data from Pakistan Social and Living Standards Measurement Survey (PSLM) (Round-1) 2004-05, collected by the Federal Bureau of Statistics Pakistan. By using a recent micro data set, this paper highlights the nature of incidence, and indirectly provides a guideline to view the extent to which health and education policy targets have been

[29] Health and education is the lowest priority of public expenditure in Pakistan. The country spends 0.5 percent of GNP on health and 2.1 percent of GDP on education GOP (2005-06), though wide inequality of distribution is existed.

enefits and how much? What kind of come-wise? Additionally, by measuring the inequalities in the distribution of the benefits of expenditures, the study will have policy implications as to how the expenditure programs can be made more effective.

The rest of the paper is organized as follows. Section II consists of methodology, and is followed by Section III, which enlists the results, and Section IV contains the conclusion and policy recommendations.

II. Methodology

The Benefit Incidence Approach

The benefit incidence approach is called the classic approach or non-behavioral approach, which was pioneered by twin World Bank studies conducted by Selowasky (1979) for Colombia and Meerman (1979) for Malaysia, Castro *et al.* (2000), Demery and Verghis (1994) and several other studies mentioned earlier.

The purpose of benefit incidence is to identify who benefits from public spending and how much. The benefit incidence approach measures how much the income of a household would have to be raised if the household had to pay for the subsidized public services at full cost. The beauty of this approach is that it uses the information on the cost of the publicly provided goods and services, taking into consideration the uses of goods and services by the different income groups and finally finds out the estimates of the distribution of benefits. The individual beneficiaries are grouped by their income level, but they can also be grouped by geographical area, ethnic group, urban and rural location, gender and so on. In analyzing the incidence of public expenditures in health and education in Pakistan, this grouping has been formulated on the basis of income, rural/urban and province/region wise.

In practice, the conduct of incidence analysis generally involves three steps.

These steps are:

1- Obtain the estimates of the unit cost or subsidy embedded the provision of a particular public service. For this step data is usually extracted from public expenditure accounts. For example,

ent cost or subsidy by level of schooling can budget.

2- Impute the subsidies to the individual or household identified as user of the service by using information available on use by different income groups. For example enrollment rates in public schools across population deciles ordered by income level ranging from poor to rich or clinic visits as reported by different households in consumer expenditure surveys.

3- Aggregate individuals or households in groups ordered by income or expenditure or any other grouping of interests such as race or gender, distribute the benefits among the different groups and arrive at an estimate of the incidence of per capita subsidies accruing to each group.

Public Subsidy

The service-specific public subsidy received by an individual is,

$$S_k = q_k c_k - f_k \qquad 1$$

Where S_k represents the subsidy received by the individual on service k, q_k indicates the quantity of service k utilized by the individual, c_k represents the unit cost of providing k in the region where individual resides, and f_k represents the amount paid for k by the individual.

$$S_j = \sum_{i=1}^{4} H_{ij} \quad \frac{E_i}{H_i} = \sum_{i=1}^{4} \frac{H_{ij}}{H_i} E_i \qquad 2$$

Where S_j is the value of the total health or education subsidy imputed to group j, H_{ij} represents the number of health visits of group j to the health or education facilities at the level i (i representing primary, secondary, higher or professional education in education and hospitals and clinics, mother child or preventive measures in health), H_i is the total number of such visits (across all groups) and E_i is the government spending on education or health at level i (with fees and other cost recovery netted out). Note that E_i/H_i is the unit subsidy of funding a health consultation or attending a school at level i. Then the share of the total health or education subsidy E_i accruing to the group is given by

$$b_{ij} \cdot p_i \qquad 3$$

Clearly, equation 3 (and indeed overall inequality in the benefit incidence) is determining two proximate factors: the share of the group in total health consultation or attending a school at each level of the facility b_{ij} and the share of the each level of the health care or education level in total health spending or total education spending P_i. The value b_{ij} reflects the household health care decision or to attend a school, whereas the value P_i reflects the government spending allocation.

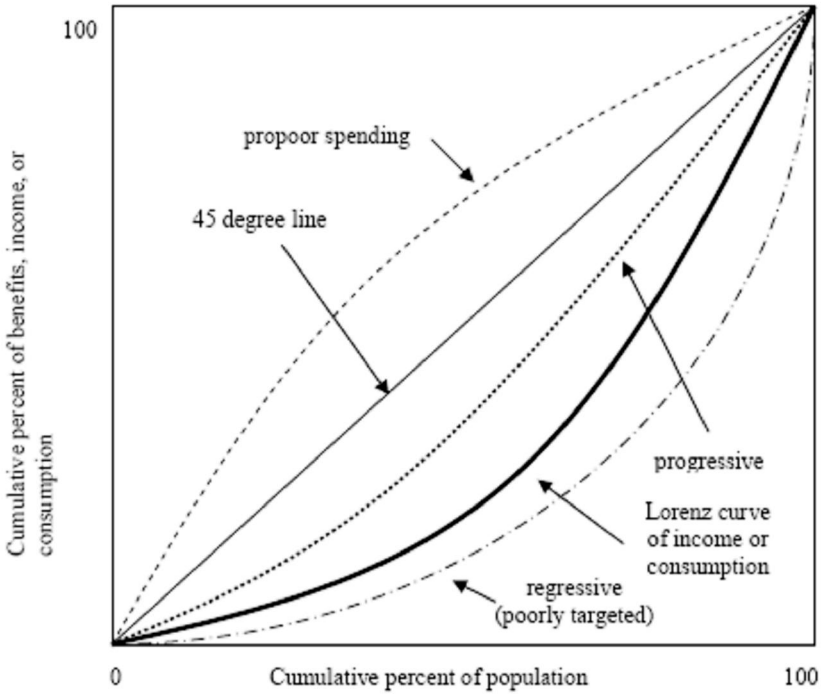
There are two useful methods for analyzing expenditure incidence results by income group: concentration curves and the concentration index. To draw a concentration curve, the population is usually arranged from lowest to highest income. Since our purpose here is to determine the effect of government expenditures, the population is arranged in ascending order of income i.e., from poorest to richest. This ranking is based on income deciles which are not equal in size in terms of numbers of households. A concentration curve shows the cumulative proportion of expenditures going to cumulative proportions of the population. So it is similar to a Lorenz curve.

However, unlike the Lorenz curve, which shows the cumulative proportion of income earned by the cumulative population, a concentration curve can lie above the diagonal: The poorest 40 percent of the population cannot earn more than 40 percent of income, but they can get more than 40 percent of spending on social grants.

The concentration curve in figure 1.1, that lies above the Lorenz curve but below the diagonal are least progressive or weakly equity enhancing i.e., it would redistribute the resources even if funded by proportional taxes, and the poorer are comparatively better off when considering both their income and public spending, compared to considering only their income. The concentration curve which lies above the diagonal shows that spending is targeted at the poor, i.e. it is strongly equity-enhancing or per capita progressive or pro-poor i.e., the poor benefit more than proportionately to their numbers. If a concentration curve lies everywhere above the 45-degree line, the benefit is per capita progressive, indicating that poorer households receive disproportionately large shares of the benefit. Concentration curves that lie below the Lorenz curve are classified as regressive. The concentration coefficient estimates the inequalities in the distribution of government expenditures and is calculated

efficient. The only difference is that the culated by keeping the income group the same. The concentration coefficient can lie in range of -1 and 1 while the GINI coefficient lies between 0 and 1. If the concentration coefficient is lower than the GINI coefficient, it shows that expenditures are more evenly distributed than income and vice versa.

igure No.1.1



This concept has been taken from Sahn and Younger (2000) who have examined the progressive nature of social sector expenditures in eight sub-Saharan African countries. They employ dominance tests, complemented by extended GINI/concentration coefficients, to determine whether health and education expenditures redistribute resources to the poor. According to them, concentration curves are a useful way to summarize information on the distributional benefits of government expenditures, and statistical testing of differences in curves is important.

Procedure of calculating net government subsidy

Net government subsidies to a household have been calculated by deducting the total individual expenditures incurred on education or health services from the total per-household government expenditures in the provision of services. Using this net subsidy, the GINI and concentration coefficients have been calculated to check the nature of the incidence of government expenditures on services. Theoretically, if the concentration coefficient is lower than the GINI coefficient, the expenditures on services are progressive or pro-poor and vice versa. Net subsidies have been used to

erent income quintiles in government easure the inequalities in the expenditure shares of different income groups.

The following data sets have been taken from different government sources.

- The information on the use of the publicly provided health and education services, income of the household and the individual expenditures on health and education have been obtained from Pakistan Social and Living Standards Measurement Survey (Round-1) 2004-05, Federal Statistics Division Government of Pakistan.

- The data on enrolment in different educational institutions have been taken from Pakistan Education Statistics 2004-05, Ministry of Education Pakistan.

- To find out per capita expenditure in health, the data on population has been obtained from National Institute of Population Study (2005).

- Total expenditures on health and education in Sindh is taken from Budget 2006-07, Vol. III, Current Expenditure on Education & Health, Finance Department, Government of Sindh.[30]

- Total expenditures on health in NWFP is taken from Demand for Grants Current Expenditure for 2006-07, Vol. III, (PART-A), Government of NWFP.

- Total expenditures in health and education in Punjab is taken from Estimate of Charged Expenditure and Demand for Grants (Current Expenditure) Vol. I (Fund No. PC 21016-PC 21016) 2006-07.

- Total expenditures on education in NWFP is taken from Demand for Grants Current Expenditure for 2006-07, Education Vol. III, (PART-A) Provincial, Government of NWFP Finance Department.

- Total expenditures in health and education in Balochistan is taken from Demand for Grants and Current Expenditure (New Accounting) for the Year 2006-07, Education Vol. III-A) Provincial, Government of Balochistan Finance Department.

[30] Grant requests are usually accepted as the budget expenditure.

...alth and education in Pakistan data is taken ... and Appropriations 2006-07, Government of Pakistan, Finance Division, Islamabad.

- The percentage distribution of the total expenditures in different sectors of health and education the percentage distribution has been taken from PRSP, Annual progress Report FY 2004-06, PRSP Secretariat, Finance Division Government of Pakistan, September 2005.

Hypotheses

The following hypotheses will be tested.

i) Government expenditures in health and education are progressive in Pakistan.

ii) There exist large inequalities in the distribution of government expenditures at different levels of the health and education sectors in Pakistan overall and at provincial and regional (urban and rural) levels.

III. Results and Discussion

Expenditure Incidence: Education[31]

The results on the incidence of expenditures at different levels of education in Pakistan are presented in Table-1.1. Government expenditures in Pakistan overall, provincial and regional levels, and at all levels of education (primary, secondary, higher and professional education) is progressive with the exceptions of large inequalities in rural NWFP and rural Sindh. The expenditure in rural Baluchistan is regressive, and largely unequal as well. All the GINI coefficients are higher than the concentration coefficient[32], which implies that expenditures are distributed evenly.

[31] Government is spending 2.1 percent of the GDP on education; out of it 42.18 percent on primary education, 23.46 percent on secondary and 12.31 percent on higher education, GOP (2005-06).

[32] The concentration coefficient shows the inequalities in the distribution of the government expenditures. This is calculated in the same as the GINI coefficient, which shows the income inequalities. The difference is that we calculate the concentration coefficient keeping income group the same. The concentration coefficient can lie in the range of -1 and 1 while the GINI coefficient lies between 0 and 1. If the concentration

coefficient is lower than the GINI coefficient it shows that expenditures are more evenly distributed than income and vice versa.

Table-1.1: Distribution of Government Education Expenditure 2005-06

	Primary					Secondary					Higher				
Region	*No. of obs.*	*Lower20 %Share in Expenditure*	*Upper20 %Share in Expenditure*	*GINI Co-efficient*	*Concentration coefficient*	*No. of Obs*	*Lower20 %Share in Expenditure*	*Upper 20% Share in Expenditure*	*GINI Co-efficient*	*Concentration Coefficient*	*No. of obs.*	*Lower20 % Share in Expenditure*	*Upper 20 % Share in Expenditure*	*GINI Co-efficient*	
Punjab	**5646**	18.688	19.97	0.333	0.013	**3790**	17.635	21.22	0.389	0.039	560	16.148	23.226	0.389	
Rural	3807	18.802	19.945	0.312	0.02	1998	17.623	23.689	0.341	0.061	161	17.579	23.632	0.316	
Urban	1839	20.563	20.563	0.354	0.006	1790	19.652	19.735	0.402	0.002	399	16.228	22.451	0.309	
Sindh	**951**	18.075	21.826	0.27	0.033	**521**	17.217	23.27	0.315	0.067	41	20.812	19.222	0.353	
Rural	563	17.671	22.877	0.369	0.042	251	18.115	26.063	0.253	0.077	8	33.555	16.578	0.322	-0.127
Urban	387	19.2	19.6	0.266	0.015	270	17.373	20.109	0.317	0.029	33	17.813	19.406	0.342	0.035
NWFP	**1364**	18.237	23.383	0.357	0.048	**915**	18.355	22.366	0.385	0.038	126	17.035	22.938	0.354	0.063
Rural	943	17.669	24.215	0.312	0.052	558	19.064	22.339	0.303	0.034	52	13.047	15.279	0.328	0.031
Urban	421	18.373	24.515	0.423	0.042	357	17.59	21.336	0.451	0.024	74	20.338	17.506	0.354	0.07
Balochistan	**2124**	18.371	23.216	0.269	0.048	**1563**	16.959	22.69	0.267	0.066	228	18.75	22.917	0.25	0.034
Rural	1499	18.616	23.106	0.327	0.488	823	16.18	23.607	0.237	0.058	64	---	---	----	---
Urban	625	18.297	19.949	0.263	0.046	740	18.658	23.69	0.264	0.053	164	20	22.5	0.252	0.03
Pakistan	**1209**	18.733	21.76	0.238	0.024	**791**	16.347	21.802	0.279	-0.022	165	17.906	21.502	0.363	0.059
Rural	802	18.495	21.585	0.293	0.029	366	16.418	22.565	0.305	0.067	39	11.594	13.026	0.32	0.025
Urban	407	19.955	21.721	0.337	0.029	425	16.5	20.306	0.377	0.037	126	16.741	20.683	0.362	0.06

...e share of the poorest 20 percent of the ...0 percent while the share of the wealthiest 20 percent of people ranges from 19 to 23 percent in Pakistan overall. At the provincial level, the share of the lowest quintile and the highest quintile are almost in the same range as in Pakistan overall. The share of the lowest quintile is lower than the highest quintile; it is more skewed in rural NWFP and Sindh, where there exist larger inequalities in the shares of the upper income groups and lowest income groups, as compared to other provinces. In rural Balochistan the expenditures are regressive, as the concentration coefficient is larger than the GINI coefficient.

In secondary education, the income-wise comparisons shows that the share of the lowest quintile in secondary education expenditure is 16.34 percent while the share of the highest quintile is 21.80 percent in Pakistan overall. At the provincial level, the share of lower income groups in public expenditures ranges from 17 percent to 20 percent and 20 to 24 percent for higher income groups in all provinces. The coefficient of concentration is lower than the GINI coefficient in all the provinces. This implies that the lower income groups are getting more benefits than higher income groups from the government expenditures in the secondary education. The share of the poorest quintile is lower than the richest quintile at the provincial level and in Pakistan overall. In urban Punjab, it is equally distributed, so that the upper and lower income quintiles receive equal benefits. However, large inequalities exist in rural Sindh, where the upper quintile receives 26 percent as compared to the lower quintile that receives only 18 percent.

Higher educational expenditure is also progressive in Pakistan overall as well as at the provincial level. The higher education expenditures are pro low-income groups in Pakistan as the concentration coefficient and GINI coefficient demonstrate. In Pakistan overall and at the provincial level, both rural and urban, the concentration coefficient is less than the GINI coefficient. This implies that expenditures are more equally distributed than income. Lower income groups are experiencing greater opportunities to access to higher education.

Although the public expenditures are progressive in higher education, there exists a large variation in its distribution. The share of the lower quintile is 18 percent as compared to 21 percent for the higher quintile in Pakistan overall. Urban areas have more access as compared to the rural areas. In rural areas, the lower quintile share is just 12 percent whereas in urban areas it is 17 percent. The share of the highest quintile is 13 percent in rural Pakistan while it is 20 percent for urban areas. At the provincial level, the share of the lower quintile is higher than the share this

It is highest in Sindh and especially in rural ower quintile is 34 percent, which is higher than all urban and rural areas in Pakistan. The share of the highest quintile varies from 17 percent to 24 percent at the provincial level. It is highest for rural Punjab and lowest for rural NWFP, which is 15 percent of the total expenditures in higher education.

Unavailability of information and the relatively small number of observations on professional education in rural/urban and overall Balochistan has restricted our analysis of public expenditures on professional education. The remaining three provinces and Pakistan overall has been incorporated in our analysis, which is reported in Table-1.2. The public expenditures on professional education are progressive. The lower quintile's share in these expenditures is 19 percent as compared to the upper quintile's share, which is 12 percent.

Table-1.2: Professional/ Technical Education

Region	Lower20 %Share in Expenditure	Upper20 %Share in Expenditure	GINI Coefficient	Concentration Coefficient
Pakistan	19.06	12.47	0.41	0.06
Punjab	18.18	21.21	0.34	0.03
Sindh	19.04	19.04	0.40	0.00
NWFP	17.14	14.28	0.23	0.25
Balochistan	NA	NA	NA	NA

N/A= Not available

The expenditures on professional/technical education at the provincial level are progressive in all the provinces of Pakistan except in the NWFP, where it is regressive. Otherwise the public expenditures are pro low income groups in Punjab and Sindh. The regressiveness of public expenditures in professional education may be due to a number of factors, for e.g. access to technical education and institutions (since most of the technical institutes are in cities) geography, customs, taboos, or social political upheavals, and level of income differences in urban and rural NWFP. Also, largely the technical educational institutes are in cities where low income groups in cities are fewer than the low income groups in rural NWFP. The shares of the lower quintile in professional/technical education

...f 12 to 19 percent while the share of the ... 14 to 21 percent.

Expenditure Incidence: Health

The net subsidies at the household level have been calculated first by subtracting total individual expenditure on the use of medical facilities at the household level from the total government expenditures in the provision of medical services at the household level. This net subsidy has been used to analyze the nature of the incidence of government expenditures on health. The net subsidy has been used to calculate the shares of different quintiles, the GINI, and concentration coefficients in order to derive progressiveness or regressiveness of expenditures on health. Variations in the shares of different quintiles provide a measure of the inequalities in the benefit of public expenditures on health received by these quintiles.

The distribution of health expenditures at different levels of health e.g. mother childcare level, general hospitals, and clinics level, and on preventive measures is skewed. There exist large inequalities across regions and at the different levels of health expenditures. In mother childcare, the health expenditure distribution is progressive which implies that lower income groups are getting greater benefits from these expenditures as compared to the higher income groups[33]. This is due to the fact that the lower income groups are unable to afford the costs at the private maternity hospitals, and prefer to avail government hospital services instead where the costs are significantly lower. Second, the high-income groups prefer to utilize private health serves where better quality facilities are available as they can afford them. The share of the lower quintile in the mother child expenditures is 11 percent and the higher quintile's share is 25 percent for Pakistan overall (see Table No. 1.3). Although the share of lowest income groups is lower, overall expenditures at mother child care level is significantly pro-low income groups and, thus progressive. The GINI coefficient is higher than the concentration coefficient.

At the provincial level, the expenditures at the mother childcare level in Punjab and Sindh are highly regressive. The share of highest quintile is almost 8 times higher than the lowest quintile's share in Punjab,

[33] The data on Balochistan in the case of mother child was not available and data on the remaining provinces and Pakistan overall was to not sufficient to undertake the analysis at rural and urban level. The analysis of the available information is presented in Table-1.3.

er in Sindh. On the other hand, mother
essive in NWFP.

Prevention is better than cure. The Government of Pakistan is spending most of its health budget on preventive measures and health facilities. Public expenditures on preventive measures and health facilities are progressive, as lower income groups are getting a higher share as compared to higher income groups. The GINI coefficient is higher than the concentration coefficient; this implies that the expenditures are more equally distributed than income. Expenditures on preventive measures and health facilities are pro low-income groups.

The share of the lower quintile in preventive expenditure is 22 percent as compared to 20 percent for the highest quintile in Pakistan overall. At the urban and rural levels in Pakistan, the share of the lower income group is lower than the higher income group. At the provincial level, the expenditures on preventive measures and the health facilities level are progressive. The GINI coefficients are higher than the concentration coefficients in all the provinces. However, small variations in the upper quintile and lower quintile shares exist. This difference is higher than the other provinces particularly in Punjab and Balochistan. Expenditures are almost 7 points higher for the upper quintile group as compared to the lower quintile group in Punjab overall, and it is 9 points higher for rural Punjab. In Sindh and NWFP nominal differences in the shares of lower and upper income quintile groups in preventive measures and health facilities expenditures exist.

Public expenditures at the level of general hospitals and clinics are progressive in Pakistan overall, both at the rural and urban levels. The share of the lower quintile at hospitals and clinics level is 16 percent and 20 percent for the highest quintile in Pakistan overall. In rural areas, the share of the lower quintile is almost double the share of the highest quintile, but for urban areas the situation is in reverse. In rural areas, the public hospitals and clinics are very few while the population is large, and low income groups have normally little options other than these clinics or dispensaries. That may be the reason the poor income groups get more benefits from the public expenditures as compared to the high income groups. The high income groups in rural areas have access to hospitals and specialized institutions in urban areas and normally prefer to get treatment from private hospitals located in urban areas.

Table-1.3: Distribution of Government Health Expenditure 2005-06

	Preventive Measures and Health Facilities					General Hospitals and Clinics					Mother Child				
Region	*No. of obs*	*Lower20 %Share in Expenditure*	*Upper20 %Share in Expenditure*	*GINI Co-efficient*	*Concentration coefficient*	*No. of obs.*	*Lower20 %Share in Expenditure*	*Upper 20% Share in Expenditure*	*GINI Co-efficient*	*Concentration Coefficient*	*No. of obs.*	*Lower20 % Share in Expenditure*	*Upper 20 % Share in Expenditure*	*GINI Co-efficient*	
Punjab	**6469**	15.423	22.363	0.382	0.076	**436**	8.028	34.783	0.362	**0.326**	**96**	2.784	20.224	0.358	
Rural	3903	14.669	23.687	0.336	0.091	255	5.585	44.68	0.311	0.456	….	---	---	--	--
Urban	2566	16.216	20.545	0.394	0.054	181	9.101	27.854	0.374	0.191	….	---	---	--	--
Sindh	**762**	19.1	21.304	0.417	0.023	**58**	11.608	17.533	0.427	**0.071**	**9**	11.236	52.295	0.29	
Rural	437	20.168	20.826	0.841	0.754	38	5.609	20.611	0.331	0.153	….	---	---	--	--
Urban	325	18.852	21.37	0.432	0.034	20	16.033	15.666	0.43	0.048	….	---	---	--	--
NWFP	**1544**	20.148	20.89	0.351	0.007	**159**	14.081	39.19	0.313	**0.236**	**32**	19.313	12.427	0.216	
Rural	982	19.222	22.139	0.276	0.02	96	16.173	28.8	0.241	0.095	….	---	---	--	--
Urban	562	19.958	22.187	0.354	0.024	63	14.721	22.06	0.309	0.181	….	---	---	--	--
Balochistan	**2741**	18.029	25.54	038	0.073	**120**	4.554	29.219	0.356	**0.369**	**21**	---	---	--	--
Rural	1689	18.028	25.554	0.343	0.073	64	2.69	43.665	0.338	0.498	….	---	---	--	--
Urban	1052	18.522	24.532	0.407	0.072	56	25.953	32.93	0.35	0.102	….	---	---	--	--
Pakistan	**1422**	22.309	20.209	0.295	0.03	**96**	16.477	20.209	0.268	**0.03**	**34**	11.328	25.327	0.294	
Rural	795	19.575	22.155	0.274	0.041	55	29.725	15.873	0.241	-0.044	….	---	---	--	--
Urban	627	19.067	20.487	0.289	0.019	41	14.351	26.495	0.314	0.285	….	---	---	--	--

...the expenditures are progressive in Punjab, ...itures are regressive in Balochistan overall, rural Balochistan and for rural Punjab.

In rural Punjab, the share of the lower quintile in public expenditures on hospitals and clinics is almost 8 times less than the share of the higher quintile. In rural Punjab, the expenditures on hospitals and clinics are regressive.

Conclusions and Policy Implications

The hypothesis that educational expenditure is progressive in Pakistan overall can be accepted. The progressiveness hypothesis regarding health expenditure is accepted partially as overall health expenditure in Pakistan is progressive but regressive at the regional and provincial levels. The hypothesis regarding the existence of large inequalities in the shares of the different quintiles in health and education expenditures cannot be rejected. The educational expenditures in overall Pakistan as well as in all the provinces in Pakistan (except primary education in rural Balochistan and professional education in NWFP) are progressive in nature. Overall, the low-income segment of the population is reaping greater benefits from the expenditures on different areas of education subheads. The expenditures on health are overall progressive in Pakistan, while it is regressive in some subhead level expenditures of health at provincial and regional levels. At the mother childcare level, expenditures are regressive in Punjab and NWFP and spending on general hospitals and clinics level are regressive in rural Punjab and in Balochistan. In the health sector more inequalities prevail in the shares of the lower and upper quintiles in government expenditures. The expenditures on mother childcare and general hospitals and clinics are regressive at least at the provincial level. The rural-urban inequalities are more profound.

Government expenditures on education are progressive while the health sector government expenditures are partially progressive as the share of the lower quintile is lower than the upper quintile.

Since inequalities in the shares of different quintiles in the benefits of government expenditures on health and education in Pakistan are widely accepted, horizontal and vertical equity in the allocation of resources to health and education both at provincial and regional level can make the expenditure programs in health and education more effective and result oriented. This means that government redistribution programs should be targeted more to specific (low income) and rural populations or improve the

fic targeting tools might be fee waivers, in-kind transfers and may result in the increase of subsidies to low income groups and enhance the share of lower quintiles and rural people. As Pakistan is among the countries with low ranking on the Human Development index (HDI), investment in human capital will result in significant returns. The increase in expenditures as a percentage of GDP on health, education and other social sector expenditures and their effective management will result in positive benefits in the long run.

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Returns to Education and Gender Differentials in Wages in Pakistan

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Abstract

Education is one of the most important factors in human development. The data from two household surveys were used to estimate the returns to education and gender disparities in wages in Pakistan. The model, an extension of Becker and Mincer models, was used to quantify the returns to investment in education. The results revealed that income gaps attributable to education level were significant. Income gaps between educated and uneducated workers in first-time employment also tend to increase with experience. Women earn significantly less than their male counterparts. These differences may be interpreted as the maximum possible effect of discrimination against women. Women also earn less because they acquire less cumulative work experience than men, as a result of breaks in their work histories, owning to the demand of motherhood and domestic chores. Education quality was much lower for students from poor families; the majority of these poor attended public school and did not have access to better quality private schools. Such differences strengthened the influence of the distribution of education and the structure of returns on income concentration.

Key words: Earnings function, gender inequality, human capital.

Introduction

The return to investment in education is a sine qua non for human capital formation. Expenditure on education, whether by the state or household, is treated as an investment flow that builds human capital (Schultz 1961; Becker 1962). Human capital is a broad concept that identifies characteristics acquired by individuals in order to increase income. This commonly includes people's knowledge and skills through education,

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deriving from their health and nutritional earnings and consumption because these factors improve mental and physical abilities of the people, raise their productivity and thus help the economy grow. Therefore, human capital is vital for the development of an economy.

Human Capital theory takes into account the growth of knowledge, skills and abilities of individuals and emphasizes the augmentation of the educated population and skilled manpower. Nevertheless human capital formation is a prerequisite for the development of physical capital and serves as a key to sustainable development. In the human capital model, an individual's earnings are the output of his own production function, where education and experience are treated as the factors of production.

Inequality in income results from the distribution of human capital across individuals in a non-degenerate way. Human capital formation is influenced by 'home-education', imparted by the parents, as well as formal public and private sector schooling. However, there is dualism in school education; the large majority is in the public school, and the children of the elite group receive education from convent type (private) schools. The literacy life expectancy (LLE) was 27 years and 13 for male and female respectively; the LLE for men was at least twice than for women (Lutz et al, 2004).

The Human Capital model in this study is an extension of Becker (1962) and Mincer (1974) models, used to quantify the returns to investment in education. Since education is the main source of human capital development, a large number of studies have estimated the returns to education for different countries [(Psacharopoulos, 1980, 1985, and 1994); (Psacharopoulos and Chu Ng, 1992)]. These studies mostly have used binary instead of continuous variables. There were only a few studies available in Pakistan that used the Mincerian Earnings Function approach to examine the returns to education [e.g. (Shabbir and Khan, 1991); (Shabbir, 1994); (Nasir and Nazli, 2000)]. The previous studies estimated the earnings function only for wage earners, whereas this study provides estimates for earnings functions of all employed groups (employers, self-employed, wage earners, unpaid family workers) by using the most recent data sets available in Pakistan. The Mincerian earnings function was based on the assumption of uniform rates of return for all schooling.

We have used the Pakistan Integrated Household Survey (PIHS) 1998-99 and 2001-02 in this study. The sample size for the 1998-99 PIHS was 16,305 households, approximately one third of which was urban. A total of 1,150 PSUs were selected. The survey covered all the four provinces, including Azad Jammu and Kashmir, Northern Areas and FATA.

The sample size of the 1998-99 PIHS survey was large enough to obtain estimates for each province and region (urban/rural). A two-stage, stratified random sampling strategy was adopted for each of the surveys. At the first sampling stage, a number of Primary Sampling Units (PSUs) were selected from the different strata. The enumerators then compiled lists of all households residing in the selected PSUs. At the second sampling stage, these lists were used to select a sample of households from each PSU randomly. In all twelve households were selected in each urban PSU, and sixteen in each rural PSU.

PIHS 2000-01

A sample size of 16,400 households was taken to provide reliable estimates of key characteristics. The entire sample of households (SSUs) was drawn from 1150 Primary Sampling Units (PSUs) out of which 500 were urban and 650 were rural. In this survey 90 sample households were not covered due to non-response/closed/non-contact and non-cooperation from the respondents.

1998-99 and 2001-02 PIHS samples.

Province	1998-99 PIHS			2001-02 PIHS		
	Urban	**Rural**	**Overall**	**Urban**	**Rural**	**Overall**
			PSU'S			
Punjab	220	238	458	220	238	458
Sindh	128	136	264	128	136	264
NWFP	72	116	188	72	116	188
Balochistan	52	88	140	52	88	140
AJK	16	28	44	16	28	44
Northern areas	12	20	32	12	20	32
FATA	-------	24	24	-------	16	16
Overall	500	650	1150	500	642	1142
			Households			
Punjab	2590	3791	6381	2599	3796	6395
Sindh	1536	2176	3712	1534	2174	3708
NWFP	859	1852	2711	857	1842	2699
Balochistan	612	1404	2016	623	1406	2029
AJK	192	448	640	192	443	635
Northern areas	143	319	462	144	317	461
FATA	--------	383	383	-------	255	255
Overall	5932	10373	16305	5949	10233	16182
			Individuals			
Punjab	16758	24619	41377	17143	24636	41779
Sindh	10052	15099	25151	11048	17200	28248
NWFP	6610	14923	21533	6504	14545	21049
Balochistan	5045	10875	15920	5056	10487	15543
AJK	1298	2939	4237	1361	3004	4365
Northern areas	1188	2453	3641	1089	2482	3571
FATA	-------	3137	3137	-------	2169	2169
Overall	40951	74045	114996	42201	74523	116724

Source: PIHS 1998-99 & 2001-02

e effect of different years of education on x level breakdown. In Pakistan, primary education consisted of five years, middle school eight years, and matriculation as ten years of schooling respectively. The intermediate (12 years schooling) certificate is the gateway to professional degree programme of four to five years and general Bachelor's degree programme of two years. Those who choose general education can pursue the Master's degree in a university for two more years. Nearly it takes sixteen to seventeen years in total to complete education at the Master's level in Pakistan. After obtaining the Master's degree, a student can proceed to the M.Phil or the PhD degree (Nasir, 2002).

Most econometric analyses do not test if the underlying data permit pooling over time, and across gender, region and province. These analyses, therefore, violate the basic aggregation assumption underlying their analysis that the underlying disaggregated functions are similar. Pooling dissimilar disaggregated functions violates the econometric requirements necessary to obtain generalizable unbiased results from the data. These results also lead to the one size fits all type of policy prescriptions that more often than not fail because they are not based on a realistic representation of reality.

In view of the above, we conducted statistical tests for similarity of functions across time, regions, province, and gender. These tests confirmed that the functions were dissimilar in all the cases tested. It is therefore incorrect to run regressions at the aggregate level without taking these differences into account explicitly. Hence regressions were run separately by time and gender (Annexure-1).

3. Results and Discussion

3.1. Earning Function of Gender:

In this study, a comprehensive analysis of the Gender Earnings Function was obtained. The explanatory variables of the earnings function comprised of years of schooling (education), experience (age minus years of education, and minus school starting age), experience^2, and a dummy variable for gender (male = 1, zero otherwise). The data in hand amply demonstrates that mean value of male and female wage rates were statistically different from each other ($p > 0.05$).

The regression results are presented in Table-1.2, 1.3 and 1.4 for the overall sample, males and females respectively for the year 1998 and 2001. All coefficients had the expected sign, significant ($p > 0.05$) and

ry. The coefficient on years of education ase in earnings resulted from one extra year of school in year 1998-99 and 9.3 percent increase in earnings in the year 2000-2001. The coefficient on Experience was positive as expected; however the parameter of $(Exp)^2$ was negative, implying concavity of the earnings function.

Table 1.2: Regression results relating the earnings function with selected variables, Pakistan

(Overall sample)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	4.713***	188.915	5.320***	186.681
Experience	0.065***	54.173	0.069***	50.197
$(Experience)^2$	-0.001***	-35.572	-0.001***	-35.227
Education	0.105***	75.265	0.093***	60.374
Male	1.699***	104.094	1.363***	72.966
Adj R^2	0.491		0.363	
F-statistics	5312.993		2994.104	

*** Significantly different from zero at the 1 percent probability level

Table-1.3: Regression results relating the earnings function with selected variables, Pakistan

(Male)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	6.400***	294.558	6.646***	260.237
Experience	0.069***	59.064	0.073***	52.515
$(Experience)^2$	-0.001***	-39.461	-0.001***	-37.225
Education	0.093***	68.426	0.087***	57.139
Adj R^2	0.272		0.211	
F- statistics	2394.012		1641.805	

*** Significantly different from zero at the 1 percent probability level

ts relating the earnings function with variables, Pakistan

(Female)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	4.616***	55.179	5.451***	64.423
Experience	0.065***	13.182	0.063***	12.073
(Experience)^2	-0.001***	-9.810	-0.001***	-9.740
Education	0.181***	33.569	0.132***	25.397
Adj R^2	0.292		0.201	
F-statistics	390.362		219.622	

*** Significantly different from zero at the 1 percent probability level

Among other results, a positive coefficient on the gender dummy (male) in the overall sample was indicative of a gender gap in labor market earnings. Females earned significantly less relative to their male counterparts. But the separate analysis for males and females showed that females enjoyed a higher return (18.1 percent and 13.2 percent) to education. These results are in line with the results of Altas and Bourguignon (2004) in case of Indonesia as well as that of Fields and Soares (2004) for Malaysia and Asadullah (2005) for Bangladesh. The coefficient on experience showed a substantial increase in wages with each additional year spent in the labor market for both male and female workers. The results for the year 1998 showed that five years of experience earned 35 percent higher wages for male workers and 32 percent higher wages for female workers as compared to their counterparts with no experience.

Similar results were obtained for the year 2001 where five years of experience earned 37.9 percent higher wages for male workers and 32.5 percent higher wages for female workers compared to male and female counterparts with no experience respectively. These results were consistent with prior studies in Pakistan [(Khan and Irfan, 1985); (Ashraf and Ashraf, 1993); (Nasir, 1999); and (Shabbir, 1991)].

rious Levels of Education by Gender

Many studies have indicated substantial differences in earnings across schooling levels in different countries. Van der Gaag and Vijverberg (1989) noted that an increase of one year in elementary, high, and university education showed an increase of 12 percent, 20 percent, and 22 percent in earnings respectively. Nasir and Hina (2000) showed that an increase of one year in education at middle school level increased earnings by 9.8 percent for male workers and 2.9 percent for female workers.

Table 1.5: Regression Results Relating Earnings Function to Selected Variables at Various Levels of Education

(overall sample)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	4.987***	183.933	5.537***	183.338
Experience	0.059***	48.805	0.065***	47.034
$(Experience)^2$	-0.001***	-33.148	-0.001***	-34.464
Urban	0.032**	2.462	-0.161	-11.238
Punjab	-0.066***	-4.698	0.015	1.021
NWFP	-0.204***	-9.660	0.097***	4.052
Balochistan	0.183***	6.431	-0.061	-1.733
Male	1.783***	107.585	1.436***	76.246
Middle	0.506***	24.892	0.442***	20.176
Matric	0.759***	39.928	0.727***	34.459
Inter	1.035***	35.188	1.006***	31.200
BA	1.337***	40.727	1.264***	35.291
Prof	1.758***	43.232	1.653***	40.152
Adj R^2	0.479		0.359	
F-statistics	1690.036		982.230	

*** Significantly different from zero at the 1 percent probability level

** Significantly different from zero at the 5 percent probability level

Relating Earnings Function to Selected rious Levels of Education

(Male)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	6.729***	290.227	6.936***	257.273
Exp	0.065***	54.986	0.069***	49.651
$(Exp)^2$	-0.001***	-38.074	-0.001***	-36.586
Urban	-0.034**	-2.645	-0.204	-13.900
Punjab	-0.075***	-5.441	-0.004	-0.247
NWFP	-0.236***	-11.575	0.055**	2.297
Balochistan	0.181***	6.633	-0.113***	-3.235
Middle	0.487***	25.488	0.429***	19.880
Matric	0.705***	38.883	0.713***	33.895
Inter	0.925***	32.304	0.950***	29.058
BA	1.210***	37.853	1.146***	30.829
Prof	1.560***	38.849	1.500***	35.162
Adj R^2	0.259		0.207	
F-statistics	612.262		438.885	

*** Significantly different from zero at the 1 percent probability level

** Significantly different from zero at the 5 percent probability level

Relating Earnings Function to Selected rious Levels of Education

(Female)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	5.046***	56.189	5.675***	63.359
Exp	0.043***	9.119	0.049***	9.609
$(Exp)^2$	0.000***	-6.743	-0.001***	-8.071
Punjab	0.006	0.120	0.127**	2.645
NWFP	-0.061	-0.703	0.382***	3.678
Balochistan	0.006	0.044	0.372**	2.077
Middle	0.886***	7.086	0.574***	5.212
Matric	1.331***	15.121	0.890**	9.799
Inter	1.768***	15.632	1.396***	11.857
BA	2.215***	17.526	1.736***	15.502
Prof	2.713***	18.859	2.414***	18.685
Urban	0.366***	7.548	0.049***	1.011
Adj R^2	0.282		0.215	
F-Statistics	102.424		65.925	

*** Significantly different from zero at the 1 probability level

** Significantly different from zero at the 5 probability level

The results were obtained in Table-1.5, 1.6 and 1.7 for the overall sample, male and female sub-samples respectively for the years 1998 and 2001.[34] The results revealed that returns to each year of education for male workers at the Matric level were 1.4 times, 1.9 times for inter, 2.5 times for BA, and 3.2 times higher for professionals as compared to middle school. Similarly for female workers the results at matric level were 1.5 times, 2 times for inter, 2.5 times for BA and 3.1 times higher for professionals as compared to the worker with middle class qualification. These results were

[34] The excluded categories for the dummy variables are: Sindh (for the provincial dummies) and primary schooling (for the level of education).

udies [Hamadani (1975), Haque (1977) Khan but these results were relatively lower than those of Nash and Nina (2006). The authors showed that returns to each year of education for male workers at matric level are three times, six times for degree education and approximately seven times higher for professional education than those of middle school years. Likewise for female workers the results were four times higher for matric, eight times higher for inter, thirteen times higher for BA and twenty times higher for professional degree holders as compared to the return for middle class qualification. The difference was perhaps due to the dependent variable used (only wage earners). In 2001, we estimated that returns to each year of education for male workers at the Matric level are 1.66 times, 2.2 times for inter, 2.67 times for BA and 3.5 times higher for professional as compared to the returns of workers with middle class schooling. The analysis showed that those who have professional degrees received the highest returns followed by BA holders. These results were again in line with previous studies in Pakistan. An interesting result from the provincial dummies is that the coefficient on Punjab, a prosperous province, is negative relative to the excluded province, Sindh. This may perhaps be due to higher wages in the suburbs of Karachi, the commercial capital. In addition, Sindh possibly started at a very low level of earnings.

3.3. Earnings Function with Quality of Education

In recent years, the cognitive skills of students have been widely debated by education experts. Students with higher cognitive skills performed better in their level of attainment in education. This in turn corresponded with a higher payoff in the labor market; there is little doubt that workers of higher cognitive skill have higher earnings, even among those with equal levels of education (Bossiere, Knight and Sabot, 1985).

Proponents of both education-as-screening device and human capital formation through education tend to agree that people with higher ability are likely to be more productive. The advocates of the screening point of view cite substantial literature suggesting there was almost no demonstrated relationship between schooling expenditure and student performance on tests of cognitive skill. (Hanushek, 1986). The advocates of the human capital view however found support in recent studies showing that, other things equal, students in states with higher teacher/student ratios and better-paid teachers obtained higher earnings (Card and Krueger, 1992). In the economics literature, normally private schooling is considered a proxy for the quality of education. Thus private school was used in this study as a dummy variable to capture the effect of education quality, along with other

l above. The results were shown in Tables

Table-1.8: Regression Results Relating Earnings Function to Selected Variables and Education Quality

(overall sample)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	4.984***	183.842	5.531***	182.961
Exp	0.059***	48.901	0.065***	47.174
$(Exp)^2$	-0.001***	-33.211	-0.001***	-34.581
Urban	0.029**	2.181	-0.166***	-11.544
Punjab	-0.066***	-4.694	0.017	1.122
NWFP	-0.203***	-9.613	0.100***	4.176
Balochistan	0.185***	6.501	-0.059	-1.662
Male	1.784***	107.660	1.437***	76.306
Middle	0.504***	24.792	0.439***	20.057
Matric	0.755***	39.710	0.725***	34.396
Inter	1.034***	35.181	1.005***	31.170
BA	1.332***	40.572	1.257***	35.074
Prof	1.748***	42.944	1.642***	39.805
Private	0.246***	4.594	0.211***	3.964
Adj R^2	0.479		0.359	
F-Statistics	1563.079		908.517	

*** Significantly different from zero at the 1 percent probability level

**Significantly different from zero at the 5 percent probability level

Relating Earnings Function to Selected nd Education Quality

(Male)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	6.726***	290.186	6.931***	256.771
Exp	0.065***	55.096	0.070***	49.764
$(Exp)^2$	-0.001***	-38.142	-0.001***	-36.683
Urban	-0.038***	-2.945	-0.209***	-14.162
Punjab	-0.074***	-5.433	-0.003	-0.174
NWFP	-0.234***	-11.525	0.058**	2.400
Balochistan	0.183***	6.717	-0.111***	-3.179
Middle	0.485***	25.402	0.428***	19.827
Matric	0.702***	38.670	0.712***	33.888
Inter	0.925***	32.324	0.949***	29.053
BA	1.205***	37.710	1.141***	30.646
Prof	1.550***	38.576	1.491***	34.911
Private	0.270***	5.116	0.187***	3.381
Adj R^2	0.260		0.208	
F-Statistics	564.157		403.492	

*** Significantly different from zero at the 1 percent probability level

**Significantly different from zero at the 5 percent probability level

s Relating Earnings Function to Selected
nd Education Quality

(Female)

Variable	1998-99		2001-02	
	Coefficient	t-value	Coefficient	t-value
Constant	5.047***	56.192	5.673***	63.340
Exp	0.043***	9.106	0.049***	9.606
$(Exp)^2$	0.000***	-6.733	-0.001***	-8.068
Urban	0.369***	7.585	0.049	0.994
Punjab	0.007	0.127	0.130***	2.704
NWFP	-0.062	-0.715	0.387***	3.721
Balochistan	0.005	0.037	0.378**	2.119
Middle	0.893***	7.123	0.550***	4.948
Matric	1.335***	15.143	0.874***	9.554
Inter	1.771***	15.652	1.386***	11.755
BA	2.221***	17.546	1.724***	15.355
Prof	2.722***	18.867	2.390***	18.342
Private	0.160	4.849	0.228	4.408
Adj R^2	0.282		0.215	
F-Statistics	98.939		60.619	

*** Significantly different from zero at the 1 percent probability level

**Significantly different from zero at the 5 percent probability level

Results showed that male workers received substantial gains when receiving education from private schools in the years 1998 and 2001 respectively. In 1998, male students having education from private schools earned 27 percent higher income as compared to their peers who received a public school education, whereas in the year 2001 male students having education from private schools earned 18.7 percent higher income as compared to their peers who received public school education. Correspondingly, female workers who have private school education earned 16 percent more income than their female counterpart having public school

percent more income in year 2001-02. These f education in the private sector was better, which in turn increased the productivity of workers and helped increased the earnings of workers. We can also see that returns have fallen for men over the period 1998/99 to 2001/02, while the reverse was true for women. A possible explanation is that the public sector educational system is geared toward men, causing women to shift toward the private system. At the same time, graduates from the private school sector are preferred in the job market.

This study has analyzed different dimensions of labor income inequality and discussed education's central role in explaining these differences. Overall, the analysis has showed that female workers were receiving less compensation as compared to their male counterparts. Experience has also appeared as major contributor towards wage differentials and contributed to substantial increases in wages with each additional year of work experience. However, returns to experience were greater for men than women. Estimates showed that each year of schooling augments the earnings of an individual by one to three percent.

The number of years of education is only an approximate indicator of a person's educational level. An insufficient quality education yields a lower return and lower income during an individual's working life. If the education quality distribution is skewed against children from low income sectors of the population, it will constitute an additional conduit for labor income concentration, and ultimately for the replication of inequality. Poor education quality severely affects the income generation potential of persons from the lower-income brackets. Higher-income families have greater purchasing power, allowing them to afford a better education for their children. The earnings function with quality of education demonstrated that persons who get their education from good private institutions receive better compensation as compared with their counterparts with a public school background. As the analysis proved that better schooling can enhance the kind of skills that pay off in the labor market, so increased investment in the quality of the nation's schools could be instrumental in raising their earning potential and defusing the public-private disparity in school quality.

4. Conclusions and Recommendations

In summary, income gaps attributable to education level were significant. This implies that income inequality arose from the education distribution pattern, as well as from the way the labor market compensated education in Pakistan. Income gaps between educated and uneducated

t also tend to increase with experience. This dual with different levels of education.

Women earn significantly less than their male counterparts. These differences may be interpreted as the maximum possible effect of discrimination against women. The labor market does not provide equal pay for different types of employment. To the extent that more women tend to work in low-paying occupations, this was reflected in lower wages for women. Women earn less also because they acquire less cumulative work experience than men, as a result of breaks in their work histories owning to the demand of motherhood and housework traditionally assigned to them. There is a need to promote female education and bring women into the formal economic sector.

Education quality was much lower for students from poor families, as the majority of these poor attended public school and do not have access to better quality private schools. The poor may also be receiving a poorer "home education." So there were major quality differences in the education received by the poor and non-poor. These differences strengthened the influence of the distribution of education and the structure of returns on income concentration.

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Annexure-1

Time Dummy

First, we run a simple Mincerian earning function consisting of the year dummy that is equal to one when the value is of year 2001 and zero otherwise. Test results show that both the intercept and slope dummy coefficients are highly significant and this shows that pooling of data sets of 1998 and 2001is not recommended.

Intercept (t-value)		Slope (t-value)		Intercept and slope
Yrdm (Year Dummy)	35.738	Educate	92.278	F-value=2658.357
		Exp	57.270	
		$(Exp)^2$	-42.195	

Due to this reason we have estimated separate regressions for different years.

We repeat this procedure for the gender dummies and results also show that the coefficient of the gender dummy (male) is highly significant which suggests that we should run separate regressions for males and females. Results of this test are given in the following table.

Gender Dummy

1998				2001			
Intercept	Slope		Intercept and slope	Intercept	Slope		Intercept and slope
104.094	Exp	54.173	F-Value	42.156	Exp	37.159	F-Value
	$(Exp)^2$	-35.572	5312.993		$(Exp)^2$	-34.096	1377.130
	Educate	75.265			Educate	43.933	

The Value of Rainfall Forecasts in the Rainfed Rice Areas of the Philippines

Abedullah* **and Sushil Pandey****

Abstract

The value of rainfall forecasts for rainfed rice production in the Philippines is estimated under the assumption that farmers adjust the quantities of fertilizer and labor if rainfall forecasts are available. Using a panel of 46 rice farmers in Tarlac, Philippines, a heteroskedastic production function with growing season rainfall (July to October) as one of the independent variables is estimated. The expected value of rainfall forecasts under the assumption of simultaneous adjustments in both fertilizer and labor was estimated to be slightly more than 1% of the net return from rice production. Taking the rainfed rice area in the Philippines of 1.2 million ha and a net return of $446/ha, the total value of the forecast was estimated to be $6.6 million per year. The expected value was also estimated under the assumption that, instead of forecasts of rainfall amounts for each year, forecasts made are for rainfall "above average", "average", or "below average". The value of rainfall forecasts was found to be highest and ranged between 1.4%-4.5% of the net return when the forecast is 'above average'. The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) could help farmers by investing more of its resource for the accurate prediction of 'above average' rainfall events.

Introduction

Agriculture is a risky enterprise with various kinds of risks involved in the production and marketing of agricultural products (Anderson and Dillon, 1992). Since risk arises due to the uncertainty about variables that affect production and profits, a reliable prediction of these uncertain variables will reduce risk. Input use and productivity when information

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able are likely to be different in comparison information is available.

Although risk can arise from several sources, climatic uncertainty is the dominant source of risk, especially under rainfed conditions. Rainfall forecasts can partially help resolve uncertainties of rice production. In the Philippines, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) provides seasonal rainfall forecasts that are classified as "above average", "below average" or "average". Although these forecasts are provided to help improve farmers' decisions about rice production, it is uncertain how valuable these forecasts are to rice farmers in economic terms. The allocation of more resources to forecast rainfall is desirable if the additional value of the rainfall forecast is higher than the additional cost of providing such a forecast. Estimates of the value of rainfall forecasts can be a useful guide in determining the optimal resource allocation for generating forecasts. To aid in this task, this study attempts to estimate the potential value of rainfall forecasts to rice farmers of Tarlac, Central Luzon, Philippines.

A Conceptual Model for Estimating the Value of Information

The value of information can be derived using the standard model of agricultural risk analysis (Anderson *et al*, 1977). Let Φ be the stochastic variable (i.e. state of nature) beyond the control of the decision-maker. If X is a vector of variable inputs that are manipulated by the decision-maker, the return $g(\Phi,X)$ earned depends on the state of nature and the vector of inputs. The function $g(\Phi,X)$ embodies input, output, and price relationships. In the absence of forecast information, decisions are based on the prior belief about the probability distribution of the stochastic variable. Let this prior probability density function be denoted by $f(\Phi)$. A risk-neutral decision-maker selects $\overset{*}{X}$ to maximize the expected return $\int g(\Phi,X) f(\Phi)d\Phi$ from the production process. The optimal decision and profits based on prior information only are the prior optimal level of inputs and the prior optimal profits, respectively. On the other hand, if the economic agent has a forecast of the value of Φ (i.e. about the state of nature) before the selection of the input vector, the decision-maker will select $\hat{X}$ to maximize $g(\Phi,X)$ for each Φ. Let the maximized value of the profit be represented by $g(\Phi,\hat{X})$. The expected value of information "V" for risk-neutral farmers is the difference between expected profit derived with and without the information and is obtained as:

$$\left.\right) h(\Phi)\,d\Phi - \int g\left(\Phi, \overset{*}{X}\right) f(\Phi)\,d\Phi$$

where, V stands for the value of information to risk-neutral farmers and $h(\Phi)$ is the probability density of uncertain event revised using the forecast information.

Following the expected utility model of decision-making under risk, risk-averse farmers are assumed to maximize the expected utility of profit (Anderson *et al*, 1977). Analogous to the model above for risk-neutral farmers, expected utility is estimated 'with' and 'without' information and the difference in the expected utility can be regarded as an indicator of the expected value (in utility terms) of rainfall predictor to risk-averse farmers. As the differences in utility that are ordinal in scale are meaningless, we have used the method followed by Byerlee and Anderson (1982) to obtain the value of information in money terms.

$$(2) \qquad E\left[U\left(\hat{\Pi} - V\right)\right] - E\left[U\left(\dot{\Pi}\right)\right] = 0$$

where, $E\left[U\left(\dot{\Pi}\right)\right]$ is the expected utility of the prior optimal act and $E\left[U\left(\hat{\Pi} - V\right)\right]$ is the expected utility of the optimal act derived using the prediction that costs \$V to acquire.

To implement model (1), it is essential to quantify the effect of inputs (X) and stochastic variables (Φ) on agricultural output. Such a relationship can be quantified using a production function. To implement model (2), the utility function that relates the level of profit to utility is also needed. A convenient form of the utility function is the constant partial risk-averse function (CPRA). It is specified as.

$$(3) \qquad U(\Pi) = \left(1 - S\right)\Pi^{(1-S)}$$

where, 'S' is the risk aversion coefficient. This form of utility function has been widely used in applied research (Sillers, 1980; Smith and Umali, 1985; Rosegrant and Roumasset, 1985).

Description of the Study Area

Socio-economic monitoring of the rice production practices of 46 farmers from the municipality of Victoria, Tarlac, Philippines was initiated

iny season with most of the land being left a has good market access and is well-linked with the town economy of Tarlac. Farmers are engaged in various off-farm and non-farm activities during the dry season to supplement their incomes. The means and the coefficients of variation (CV) of output and input variables are reported in Table-1. Based on the long-term weather record (1976-1995), the mean annual rainfall in Victoria is 1,649 mm. The variation in rainfall during the rice-growing season (July-October) is shown in Figure 1.

Plot level data from the sample of 46 farmers were collected for the period 1990-95. All inputs and outputs were recorded in a survey questionnaire, which was administered every year to the same group of farmers. Unbroken panel data for 420 plots for each of the six years were utilized for estimating the production function. The only source of uncertainty considered was rainfall which was specified in the model as the total rainfall during the rice-growing season (July-October). The rainfall values are the same for all plots in a given year but differ from year to year. For biological reasons, it would have been more appropriate to specify rainfall as weekly or monthly total as compared to the seasonal total. However, we used the seasonal total, as a reliable estimation of the production responses for weekly or monthly rainfall using production data for only six years would have been constrained by the limited degrees of freedom.

Production Function Estimation

When production functions are estimated using a combination of cross-section and time-series data, heteroskedasticity may lead to asymptotically inefficient parameter estimates (Just and Pope, 1978). The Breusch-Pagan test rejected the null hypothesis of homoskedasticity at the 5% level. To correct for heteroskedasticity, a multistage production function estimation technique suggested by Antle (1983) was used. A quadratic production function as specified in equation (4) was used.

$$Y = \alpha_1 + \alpha_2 X_1 + \alpha_3 X_1^2 + \alpha_4 X_2 + \alpha_5 X_2^2 + \alpha_6 Z + \alpha_7 Z^2 + \alpha_8 X_1 X_2 + \alpha_9 X_1 Z + \alpha_{10} X_2 Z + \nu \quad (4)$$

where, Y, X1, X2, and Z represent yield, total labor, fertilizer (total of N, P, and K), and total rainfall during the rice production period (from July to October), respectively. The stochastic error term is represented by ν. The

seed, herbicide, pesticide and elemental of N, P, and K) and output with descriptive statistics is given in Table-1.

The parameter estimates using Antles' method are presented in Table-2. The coefficients of labor, labor^2, fertilizer, fertilizer^2, rainfall and rainfall^2 all have the expected signs. The joint effects of rain and labor, and rain and fertilizer are positive and significant. The interaction term between fertilizer and labor is negative, indicating that these two inputs have a substitute relationship in rice production.

Procedure for Estimating the Value of Rainfall Forecast

In valuing the forecasts, a prior probability distribution of rainfall is required. We assumed farmers' prior probability of rainfall to be equivalent to the historical distribution of total rainfall during the rice production period. The probability distribution was estimated by applying the sparse data rule (Anderson *et al*, 1977) to the historical rainfall for the period 1977-95. For a given value of the decision variable, profits were generated for each year by substituting the rainfall for that particular year into the production function. The expected profit was then calculated by using the corresponding rainfall probability weights. This process was repeated for all possible values of the decision variable and the value of the decision variable that generated the maximum expected profit was taken as the prior optimal decision. For risk-averse farmers, the prior maximal expected utility was similarly calculated by substituting the profit for each decision into equation (3) and using the corresponding probability weights. Siller (1980) concluded that 78% of rice farmers in Nueva Ecija, Philippines lie in the two intermediate categories of risk aversion. The S=0.8 is the common end point of these two categories. The value of risk aversion coefficient used in this study was 0.8.

The rainfall forecast for each year was generated by random sampling from the discrete probability distribution of the historical rainfall data. Assuming that the prediction is perfect, optimal profit for this forecast was then obtained using the estimated production function. As prediction is assumed to be perfect, the probability distribution of the forecast is also the historical probability distribution of rainfall. Using the historical distribution, the expected profit when a perfect predictor of rainfall is available was then calculated. The difference between this expected profit and the expected profit of the prior optimal act is the expected value of the perfect predictor of rainfall. A similar procedure was used for the risk-averse case and equation (2) was utilized to obtain the value of a perfect predictor

on of the value of the perfect predictor is to explicitly obtain the likelihood function, which is an indicator of the accuracy of the predictor. Since no rainfall predictor can be perfect, the estimated value of the predictor can be considered as the upper limit of the value of rainfall forecast.

As rainfall forecasts in the Philippines are provided as 'average', 'below average', or 'above average', we also estimated the value of these forecasts. The 19-year historical July-October total rainfall fluctuated between 700-1650 mm (IRRI, Various Issues). We divided this total range of rainfall into three categories, below average (between 700 and 1000 mm of rainfall), average (between 1050 and 1300 mm of rainfall), and above average (between 1350 and 1650 mm of rainfall). To calculate the value of the perfect predictor, predicted rainfall values were limited within the range defined by these prediction categories. The prior optimal expected profit was obtained as before. The posterior expected profit was estimated by using the optimal profits for each perfect prediction (randomly selected, within the particular rainfall category) and the corresponding conditional probabilities. The difference between these two expected profits is the value of a particular category of forecast for a risk-neutral farmer. A similar procedure was used for the risk-averse case.

Labor and fertilizer are the two decision variables considered. Farmers may adjust either or both of them from their prior optimal values if rainfall forecasts are available. We estimated the value of rainfall forecast under the assumptions that (a) only labor is adjusted to its posterior optimal value while the fertilizer is fixed at its sample average, (b) only fertilizer is adjusted to the posterior optimal value while labor is kept fixed at its sample average, and (c) both labor and fertilizer are adjusted simultaneously to their posterior optimal values.

Value of Rainfall Forecasts

The estimated values of a perfect rainfall predictor for risk-neutral and risk-averse farmers are presented in Table-3. The expected value of a rainfall forecast, if farmers are assumed to adjust fertilizer application when rainfall predictions are available, are $1.92 and $2/ha for risk-neutral and risk-averse farmers, respectively. These values account for 0.43% and 0.46% of the net return from rice production in the study area. The expected values of rainfall forecasts under the assumption that only labor is adjusted are $4.08 and $4.29/ha for risk-neutral and risk-averse farmers, respectively. These comprise 0.92% and 0.96%, respectively, of the net return from rice production.

a perfect predictor of rainfall (under the ...fertilizer and labor simultaneously) for risk-neutral and risk-averse farmers are $5.50 and $5.79/ha, respectively. In terms of percentage of the net return these values are 1.23% and 1.29%, respectively. The effect of risk aversion on the value of rainfall forecast was found to be minimal.

The cost of acquiring information was not included in the above calculation, implying that the results indicate the expected gross benefits of the forecast. Net benefits depend on the cost of obtaining and using information. Gross benefits, as estimated here, are useful to indicate the maximum amount a farmer would be willing to pay to obtain the forecast.

The expected values of the forecast under the assumption that the forecasts are 'below average' (between 700 and 1000 mm of rainfall), 'average' (between 1050 and 1300 mm of rainfall) or 'above average' (between 1350 and 1650 mm of rainfall) were also estimated (Table-4). In the case of simultaneous adjustment of fertilizer and labor, values vary from $1.58 to $20/ha depending on the type of the forecast and the assumption about the risk attitude of farmers. In terms of percentage of net return, these values lie in the range of 0.35-4.52%. The 'above average' forecasts are found to be more valuable to farmers than 'below average' and 'average' forecasts. The PAGASA could hence help farmers more by investing more of its resource for the accurate prediction of 'above average' rainfall events.

The estimates of the value of rainfall forecasts obtained here are only a small fraction of the net return. In rainfed agriculture where rainfall is the major source of uncertainty, such a low value may appear to be somewhat surprising. This may partly be the result of the model specification in which rainfall is included as the seasonal total and the only two decision variables considered are labor and fertilizer application. Nevertheless, estimates derived here are comparable to those obtained for other countries. Mejelde *et al*, (1988) reported the value of rainfall forecasts varying from 5% to 13% of the net return in corn production in Illinois. Pannell (1994) estimated the value of information from herbicide decision making in wheat production in Australia to be between 0-15% of the gross margin from the crop. Marshall *et al*, (1996) estimated the value of seasonal forecasts for dryland wheat production in Australia to be between 0-6% of the net return. Even though the value of the forecast expressed as a percentage of net return may be small, the total absolute value can be quite large depending on the size of the area covered by the forecast. Taking the rainfed rice area in the Philippines of 1.2 million hectare and a net return

rainfed rice farmers would be $6.6 million forecast is only 1.23% of the net return.

Concluding Remarks

Overall, the expected value of a hypothetical perfect predictor of rainfall is found to be between $2/ha-$6/ha for moderate risk-averse farmers, which is little higher than 1% of the net return earned by farmers from rice production in the study area. This is an upper bound estimate of the value of a rainfall predictor, since the prediction accuracy of a realistic predictor is likely to be less than 100%. As rainfall prediction in the Philippines is provided cost free, this is also an estimate of its net value to farmers. The effect of risk aversion on the value of the forecast was found to be minimal. Our results also indicate that the value of information is asymmetrical, with the 'above average' forecast being four times more valuable than the 'average' forecast and about two times more valuable than the 'below average' forecast. An important implication of this finding is that additional efforts by PAGASA to correctly predict the 'above average' rainfall events may be justifiable. Overall, the average value of a perfect predictor of seasonal rainfall to the rainfed rice farmers of the Philippines was estimated to be $6.6 million per year.

The value of the forecast depends critically on the quality and the timeliness of the forecast (Mjelde *et al.*, 1988). Forecasts are valuable only if they are received before inputs have been applied. We did not investigate the timeliness issue due to limitations of data for estimating production functions that adequately capture temporal interactions between managed inputs and rainfall. Similarly, we have considered rainfall as the only source of uncertainty on the assumption that rainfall variability is the major source of risk in rainfed rice production. Further expansion of the approach used to include these refinements is suggested.

nput and Output Use in Victoria, Tarlac, Philippines.

Input/output	Units	Average	Standard deviation
Total labor[a]	(days/ha)	55	15
Seed	(kg/ha)	110	47
Fertilizer (NPK)	(kg/ha)	94	42
Herbicide	(kg a.i./ha)	0.14	0.21
Pesticide	(kg a.i./ha)	0.09	0.14
Yield	(tons/ha)	3.35	1.07

a. Includes family labor and hired labor.

Table-2: Quadratic Production Function Estimates with Antle's Technique in Victoria, Tarlac, Philippines[a].

Explanatory variables	Coefficients	Standard errors
Intercept	-72.9E-03^{ns}	134.1E-02
Labor	30.2E-03*	18.2E-03
Fertilizer	18.2E-03***	7.6E-03
Rain	1.4E-03^{ns}	1.6E-03
Labor^2	-0.2E-03***	9.1E-05
Fertilizer^2	-3.8E-05***	1.7E-05
Rain^2	-1.1E-06**	5.6E-07
Labor*Fertilizer	-0.2E-03***	7.1E-05
Labor*Rain	1.7E-05*	1E-05
Fertilizer*Rain	5.1E-06***	4.4E-07
R^2	0.25	
n	420	

*** = significant at 1%, ** = significant at 5%, * = significant at 10%, ^{ns} = not significant

ue of forecast in ($/ha) under different
n Victoria, Tarlac, Philippines

Forecast and adjustment of inputs	Value of rainfall forecast[a]	
	Risk-neutral	Risk-averse
Fertilizer adjustment only	1.92	2.04
	(0.43)	(0.45)
Labor adjustment only	4.08	4.29
	(0.92)	(0.96)
Simultaneous adjustment of fertilizer and labor	5.50	5.79
	(1.23)	(1.29)

[a] Value in parenthesis represents the percentage of net return.

Table-4: The expected value of different rainfall forecasts for rice production period in ($/ha) under different input adjustment in Victoria, Tarlac, Philippines.

Forecast and adjustment of inputs	Value of rainfall forecast[a]	
	Risk-neutral	Risk-averse
Below average (700-1000) mm.		
Fertilizer adjustment only	1.42	1.50
	(0.32)	(0.34)
Labor adjustment only	2.71	2.92
	(0.61)	(0.65)
Simultaneous adjustment of fertilizer and labor	3.42	3.67
	(0.77)	(0.82)
Average (1050-1300) mm.		
Fertilizer adjustment only	0.50	0.58
	(0.11)	(0.13)
Labor adjustment only	1.25	1.33
	(0.28)	(0.30)
Simultaneous adjustment of fertilizer and labor	1.58	1.71
	(0.35)	(0.38)
Above average (1350-1650) mm.		
Fertilizer adjustment only	6.17	6.50
	(1.38)	(1.46)
Labor adjustment only	13.75	14.17
	(3.08)	(3.18)
Simultaneous adjustment of fertilizer and labor	19.33	20.17
	(4.33)	(4.52)

[a] Value in parenthesis represents the percentage of net return.

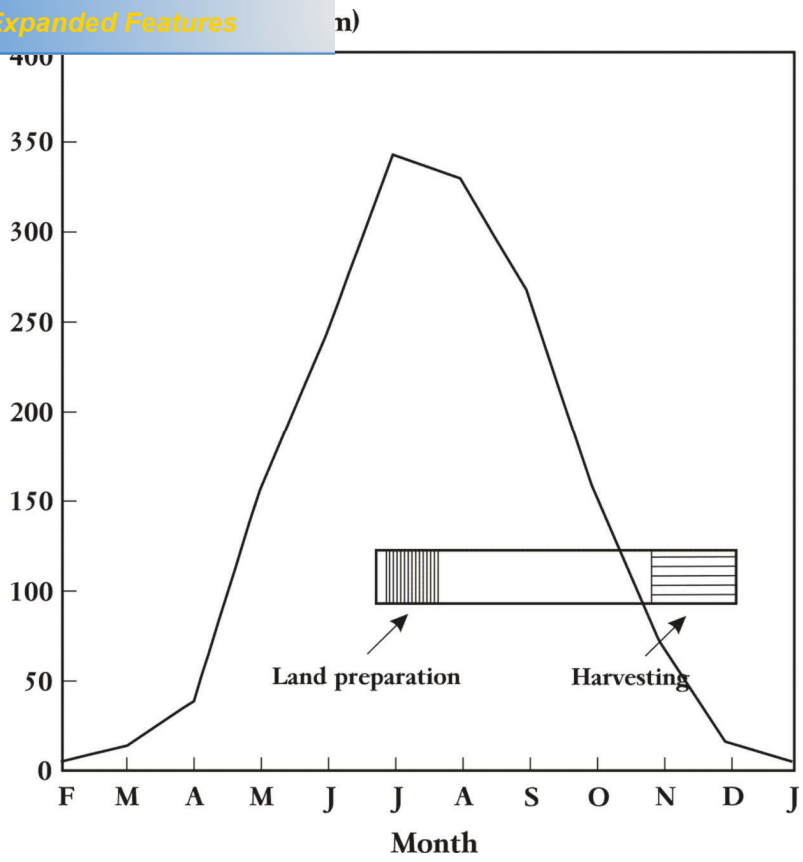

Figure 1. Average monthly rainfall over 1977-95, Victoria, Tarlac, Philippines.

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Exchange Market Pressure and Monetary Policy: Evidence from Pakistan

M. Idrees Khawaja*

Abstract

The study employs the Girton and Roper (1977) measure of exchange market pressure (defined as the sum of exchange rate depreciation and foreign reserves outflow), to examine the interaction between exchange market pressure and monetary variables, viz. domestic credit (Reserve Money) and the interest rate. Evidence from impulse response functions suggests that domestic credit has remained the dominant tool of monetary policy for managing exchange market pressure. The increase in domestic credit upon increases in exchange market pressure (during 1991-98) was imprudent. The results suggest that fiscal needs/growth objectives might have dominated external account considerations during this period. Post 9/11 there is evidence of sterilized intervention in the forex market. The interest rate has also weakly served as the tool of monetary policy during the hay days of foreign currency deposits (1991-98). The finding implies that, for the interest rate to work as tool of monetary policy vis-a-vis exchange market pressure, a reasonable degree of capital mobility is called for.

1. Introduction

Exchange market pressure generally refers to disequilibrium in the money market. Knowledge of the mechanisms and instruments that help achieve money market equilibrium has important policy implications. Monetary approaches to balance of payments and monetary approaches to the exchange rate respectively hold that, under the fixed exchange rate regime, the money market equilibrium is achieved through changes in

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se of a pure float, the exchange rate bears

Under the managed float exchange rate regime, changes in the exchange rate and variation in foreign reserves are the two sides of the same coin - hide one and the other shows up. For example, post 9/11 the State Bank of Pakistan (SBP) actively intervened in the forex market - first to smoothen the appreciation of the exchange rate by purchasing foreign currency from the forex market thereby building up foreign reserves. Moreover, since November 2004, SBP has been providing foreign currency from reserves for oil imports to avoid depreciation of the exchange rate. Therefore under a managed float, to examine the disequilibrium in the money market, we need a composite variable that incorporates changes in the exchange rate as well as variation in foreign reserves. Girton and Roper (1977) construct the requisite composite variable as the 'simple sum of exchange rate depreciation and variation in foreign reserves scaled by monetary base' and call it exchange market pressure (*emp*).

This study uses the composite variable *emp* rather than foreign reserves or the exchange rate, to study the interaction between monetary variables and the external account. Specifically, the study examines the nature of the influence of monetary variables *viz.* domestic credit and the interest rate upon exchange market pressure and vice versa. The analysis is likely to facilitate monetary management. The study will also reveal whether the instrument of domestic credit or the interest rate has been used by the authorities to manage exchange market pressure. The use of domestic credit implies quantitative monetary management, i.e. directly varying the level of money supply whereas the use of the interest rate implies market-based monetary management. The two monetary regimes carry different implications for the economy.

The study is organized as follows: Section 2 is devoted to the review of the literature on the *emp* model, Section 3 develops the theoretical and empirical framework for the study, Section 4 concerns data issues, Section 5 reports and analyzes the results from the econometric investigation and Section 6 concludes.

2. Literature Review

[35] To understand the mechanisms, for different exchange rate regimes, that help achieve equilibrium under the monetary approach see Frenkel (1976) Mussa (1976) &and Pilbeam (1999).

ge market pressure as a composite variable 1977). They developed a model to explain both the exchange rate movement and variation in foreign reserves and referred to the composite variable *(r + e)* as exchange market pressure, where *r* represents the change in foreign reserves scaled by monetary base (reserve money) and *e* reflects the percentage change in the exchange rate over the period under consideration.

2.1. Girton and Roper's emp Model

The main theoretical proposition of the Girton and Roper (henceforth GR) model is that the domestic money market equilibrium if disturbed is restored through some combination of the currency depreciation/appreciation and foreign reserves outflow/inflow. The excess domestic money supply will cause a combination of currency depreciation and reserves outflow while excess domestic money demand will cause some combination of currency appreciation and reserves inflow to restore the money market equilibrium.

GR's model organizes the analysis around demand and supply of national monies. According to their formulation, *emp* is a function of growth in domestic credit, growth in foreign money supply and the differential between growth of domestic and foreign real income. The assumptions, explicit and implicit, in the GR model are: Stable demand for money function (money multiplier is held constant), purchasing power parity holds, flow equilibrium in the money market and domestic and foreign interest rates are assumed to grow at equal rate, that is, the interest rate differential is held constant.

GR's model differs from other monetary models of Balance of Payments (BOP) in three respects. First, the dependent variable is exchange market pressure, defined as the sum *r + e*, rather than the BOP *per se*, second the model takes the view that a country's monetary policy can be judged as tight or loose only through comparison with the monetary policy being implemented in rest of the world. Third GR's model holds for all exchange rate regimes (of the dependent variable *r +e*, *r* and *e* are respectively zero, under floating and fixed exchange regimes, and the rest of the model remains unchanged).

The GR model has been applied extensively, with certain modifications. The applications include Cannolly and Silveira (1979) to Brazil, Paradhan et al. (1989), to India, Modeste (1981) to Argentina, Kim (1985) to Korea and Wohar and Lee (1992) to Japan, Thornton (1995),

...n countries, Kamaly and Erbil (2000) for ...Tanner (2002) for 32 countries and Bautista and Bautista (2002) for Philippines.

The recent *emp* models, by assuming a small open economy, obviates from monetary dependence apparent in GR's model. The earlier models held that foreign disturbances are transmitted to the home country through growth in foreign money supply. However, the recent models rely upon interest rate differentials and inflation differentials to carry-over the foreign disturbances to the domestic economy. The recent models have also relaxed the assumption that purchasing power parity holds. Another improvement affected at the empirical stage in recent studies is that these, by using VAR, take care of the endogeneity in the *emp* model that earlier studies failed to tackle. Till Thornton (1995), the *emp* model was primarily used only to validate the monetary approach. However recent studies tend to examine whether the tool of monetary policy, *viz-a viz* exchange market pressure, has been domestic credit or the interest rate.

All the studies listed above validate the monetary approach. Most of the studies referred above have tested the efficacy of the *emp* model by using foreign reserves as the sole dependent variable rather than the composite variable *emp*. Except for Wohar and Lee (for Japan) and Paradhan et al. (for India), others find that the fit deteriorates significantly when foreign reserves (r) is used as the sole dependent variable. This proves the efficacy of the *emp* model. Tanner (2001, 2002) and Bautista and Bautista (2005) find that the feedback relation from exchange market pressure to domestic credit is positive. The authors take this to be a sign of sterilization of reserves outflow. Kamaly and Erbil (2000), Tanner (2001, 2002) find that domestic credit has been the dominant tool for managing exchange market pressure in the countries examined. Bautista and Bautista (2005), which examines *emp* in Philippines, covers the Asian currency crises period as well. They find that during the crises period exchange market pressure increases with the increase in the interest rate differential. This finding is against the conventional wisdom. The authors infer from this that in times of currency crisis, the interest rate cannot be relied upon as a tool of monetary management *viz-a-viz* exchange market pressure.

3. Theoretical and Empirical Framework

3.1. The Model

We use a model similar to the one used by Kamaly and Erbil (2000) and Tanner (2001, 2002). The model is:

$$-\pi_t^* + z_t \qquad (3.1)$$

Where:

emp_t : Exchange Market Pressure at time t,

dc_t : Growth in domestic credit (scaled by monetary base)

y_t : Growth in real income

i_t : Growth in nominal interest rate

π_t^* : Growth in international inflation

z_t : Deviation from PPP rate

The system given by equation (3.1) has endogeneity ' not only the domestic credit and interest rate influence exchange market pressure (*emp*) but *emp* also influences the two variables[36]. Given the endogeneity in equation (3.1), we use VAR framework to estimate equation 3.1[37]. The VAR framework for equation 3.1 can be written as:

$$q_t = a_0 + \sum_{J=1}^{P} A_j q_{t-j} + \delta z_t + \lambda \pi_t^* + e_t \qquad (3.2)$$

where $q_t = dc_t, emp_t, y_t, i_t$, A_j is a vector of coefficients of the endogenous variables, ŭ and ə represent the coefficients of the two exogenous variables: z_t and π_t^* and $e_t = e_{dc_t}$, e_{i_t} e_{y_t} e_{emp_t} is a vector of innovation. Each element of the innovation vector e_t is in turn composed of own error terms w_t and contemporaneous correlation, based on assumed *Ordering*, with other innovation ($\beta_{i's}$).

3.2. Identification of IRF's: Choleski decomposition:

[36] For detailed reasoning in this regard see Kamaly and Erbil (2000).

[37] To ascertain the suitability of VAR framework for estimation of a system like equation (3.1) see Tanner (2001, 2002) and Kamaly and Erbil (2000) and Gujarati (1998). For technical aspects of VAR framework see Enders (1995).

stem as given by equation (3.2) is under pulse response functions (IRF's) *Choleski* decomposition is used to impose restrictions on the four variables in the VAR. *Ordering* of the variables assumed for the purpose is: $[dc_t \ i_t \ y_t \ emp_t]$. Sensitivity of the results to following alternate *orderings* will be tested.

1) $[dc_t \ i_t \ emp_t \ y_t]$

2) $[dc_t \ emp_t \ i_t \ y_t]$

3) $[emp_t \ dc_t \ i_t \ y_t]$

3.2.1. Economic rationale for the assumed ordering

Domestic credit, being a policy variable, influences all other variables contemporaneously but is itself influenced by own contemporaneous innovation only. The interest rate despite being a policy variable is partly determined in the market; therefore its exogeneity ranking is lower than domestic credit. Real income is known to be influenced by monetary variables, and therefore its exogeneity ranking is lower than the two monetary variables. Monetary variables as well as real variables do influence the level of the exchange rate and foreign reserves. Hence the lowest exogeneity ranking is that of exchange market pressure.

3.3. Hypotheses

Our hypotheses of interest are extracted from equation (3.2). These are:

- $\beta_{emp_t.dc_t} w_{dc_t} > 0$ and,
- $\beta_{emp_t.i_t} w_{emp_t} > 0$

The first one implies that a shock to innovation in domestic credit has a positive impact on exchange market pressure while the second one posits that the impact of a shock to innovation in the interest rate on exchange market pressure is positive. The discussion on the theoretical foundations of the hypotheses follows.

3.3.1. Domestic credit: Positive Relationship with emp

f a shock to innovation in domestic credit
ms from the monetary approach: According
to the monetary approach to BOP, payment imbalances reflect disequilibrium in the money market. The approach posits that BOP deficits and BOP surpluses respectively correct for the excess supply of money and excess demand for money. In the case of a free float, the adjustment burden falls on the exchange rate while under a managed float, the foreign reserves and the exchange rate together (i.e. *emp*) shoulder the adjustment burden. The monetary authority, using its own discretion, determines the adjustment proportion.

Given the foregoing, an increase in domestic credit is offset by exchange rate depreciation or foreign reserves outflow or some combination of the two; that is, an increase in exchange market pressure. Hence the positive impact of a change in domestic credit on exchange market pressure occurs.

3.3.2. Interest Rate: Positive Relationship with emp

The theoretical foundation for the relationship between a shock to innovation in the interest rate and exchange market pressure is drawn from the theory of money demand and interest rate parity theory.

According to Keynesian theory of money demand, the interest rate bears a negative relationship with money demand. The following flow chart shows the channel through which the interest rate exercises influence on exchange market pressure:

> Increase in interest rate □ decrease in real money demand □ foreign reserves outflow/exchange rate depreciation □ increase in exchange market pressure.

We predict a positive relationship between the interest rate and exchange market pressure. Frenkel (1979) discusses how there are conflicting views, *viz.* Chicago view and Keynesian view regarding the relationship between the interest rate and exchange rate. The essence of the Chicago view is indicated in the flow chart given above i.e. the increase in the interest rate causes the money demand to decline, which in turn causes the exchange rate to depreciate. This view predicts a negative relationship between the interest rate and exchange rate. The Keynesian view argues that an increase in the domestic interest rate, given the foreign interest rate, makes the domestic securities more attractive. This attracts foreign capital into the country that causes the foreign reserves to increase and the

...us the Keynesian view predicts a negative ...est rate and the exchange rate. The view assumes perfect capital mobility and one condition for capital mobility is that domestic and foreign securities should be equally risky. (Pilbeam, 1998, p. 162)

To assess the applicability of the Keynesian view in Pakistan, let us assume that the interest rate in Pakistan is sufficiently higher than that in the US. Can we expect that Americans will transfer money from their banks in the US to banks in Pakistan? Certainly not, and the reason is that money in Pakistani banks is not considered as safe as in the US. As Pakistani securities are perceived as more risky relative to foreign ones, we therefore do not expect the Keynesian view to hold in Pakistan. Given the non applicability of the Keynesian view we feel that only the Chicago view is at work in Pakistan and therefore we posit a positive relationship between the interest rate and exchange market pressure.

4. The Data

4.1. Data Span

The data span of the study is: 1991:04-2005:12. Given that the exchange market pressure model is particularly applicable to managed floats (though it is possible to use the model for other exchange rate regimes as well), one logical starting point of the data span is January 08, 1982 — the day Pakistan adopted a managed float. However we use 1991 as the starting point because of the following reason. Prior to March 1991, the interest rate was regulated by SBP, and the interest rate on Government Treasury Depository Receipts (GTDRs), whose features are similar to that of Treasury Bills now in vogue, was changed only once during the eight years preceding March 1991. This is enough to conclude that the interest rate was not being used as an instrument of monetary policy prior to 1991. Since our objective is to determine whether the dominant tool of monetary policy *vis-à-vis* exchange market pressure is 'interest rate' or 'domestic credit', we cannot include data prior to March 1991. Hence the small sample of 14.9 years that we have. Besides we use three sub-spans spanning over 7.2, 7.7 and 4.4 years. The characteristics of these sub-spans are indicated in Table-4.1 below.

Table-4.1: Data Span: Characteristics

From	To	Peculiarity	Length (Years)

		of the move towards market netary policy (Full span)	14.9
1991:04	1998:05	Life period of Foreign Currency Deposits (FCDs)	7.2
1998:06	2005:12	Post-FCDs freeze / 9/11	7.7
2001:09	2005:12	Post 9/11	4.4

The motivation for the full span of 14.9 years has been discussed above. The motivation for the sub spans follows:

4.1.2. Sub Spans: 1991:04-1998:05 & 1998:06-05

Foreign Currency Deposit Accounts (FCDs) during their short active life had been not only a key source of foreign currency for the authorities but had led to *dollarization* as well. Both in turn influenced exchange market pressure and the monetary policy. The developments call for analysis of the relationship that prevailed between the exchange market pressure and the monetary variables. Secondly in May 1998, when Pakistan became a nuclear power, foreign aid sanctions were imposed on Pakistan. The post-freeze/post-sanctions span will allow us to examine as to how the authorities managed the pressure in the crisis period.

4.1.3. Sub-Span: 2001:10-2005:12

Certain events triggered by 9/11 led to a dramatic reduction in exchange market pressure. It is important to see how the monetary policy reacted to the change in the direction of exchange market pressure. Hence we use the data-span 2001:09-2005:12.

4.2. Frequency

Data frequency is monthly. The motivation for using high frequency data (among others) is that the data includes domestic credit, interest rate, exchange rate and foreign reserves. These variables have dynamic properties that can be best captured with high frequency data. Besides, as mentioned above, we have a relatively small sample of 14.9 years. Given the small sample size, the use of annual data is ruled out for reliable econometric investigation. Similarly, the smaller sub-spans, referred above, rule out the use of even quarterly data.

4.3. Variables

n the empirical model given by equation sure (emp_t), Domestic Credit (dc_t), Interest rate [Six month T-bill rate: (i_t)], Real income [Proxy: Industrial production (y_t)][38], International inflation [Proxy: U.S. inflation ($\hat{j}^*_t$)] and Deviation from purchasing power parity (z_t).

Of the six variables mentioned above, data for the series i_t, y_t and $\hat{j}^*_t$ are directly available in published statistics while data for the series dc_t, emp_t and z_t is to be generated. This in turn requires data on additional variables. (The generation of the series is discussed in Annexure A). In all we required data on: nominal exchange rate, foreign reserves, industrial production index, domestic credit, interest rate and CPI (US and Pakistan). The data was obtained from International Financial Statistics (IFS) CD-ROM (May 2006).

4.4. Stationarity

All the data series have been tested for the absence of unit root. The tests employed include Dickey Fuller/ Augmented Dickey Fuller (ADF) and the seasonal unit root test proposed by proposed by Baeulieu and Miron (1993). We employ the seasonal root test because the monthly data is more prone to seasonality. The ADF test, as well as the seasonal unit root test, shows that all the series exhibit stationarity. The result is not surprising as the model employs all variables in growth form.

5. VAR Estimation of emp Model

VAR estimation involves regressing each one of the endogenous variables on its own lags. To estimate the VAR system, we must decide the lag order of the endogenous variables to be incorporated in the VAR system. Besides, following the standard AIC method for selection of the lag order, we additionally ensure that residuals of the regressions that form part of the VAR system do not exhibit serial correlation. Use of the foregoing process delivers the lags mentioned against each data span in Table-5.1. These lags are in conformity with AIC method as well.

Table-5.1: Data Spans: Lags of Dependent Variables for VAR system

	Interval	Duration: No. of Years	Lags of dependent variable

[38] Monthly data on real income is not available. The use of industrial production as a proxy for real income is well established.

	-2005:12	14.9	4
	05	11	3
FCD Span	1991-04-1998-05	7.2	2
Post FCD Freeze/Post-aid sanctions/ 9/11	1998:06-2005:12	7.7	2
Post 9/11	2001:09-2005:12	4.4	2

5.1. Impulse Response Functions (IRF's):

The main tool of the unrestricted VAR system is the Impulse Response Function (IRF) generated by a shock to innovation in each of the endogenous variables. Accordingly, after estimation of the VAR system (for each data span) given by equation (3.2), IRF's have been generated by shocks to innovation to the endogenous variables. The results are presented below.

5.1.1. Effect of Domestic Credit growth on Exchange Market Pressure:

The relevant IRF's (Table-5.2 and fig. 5.1) show a positive and contemporaneous effect of domestic credit growth (dc_t) on exchange market pressure (emp_t).

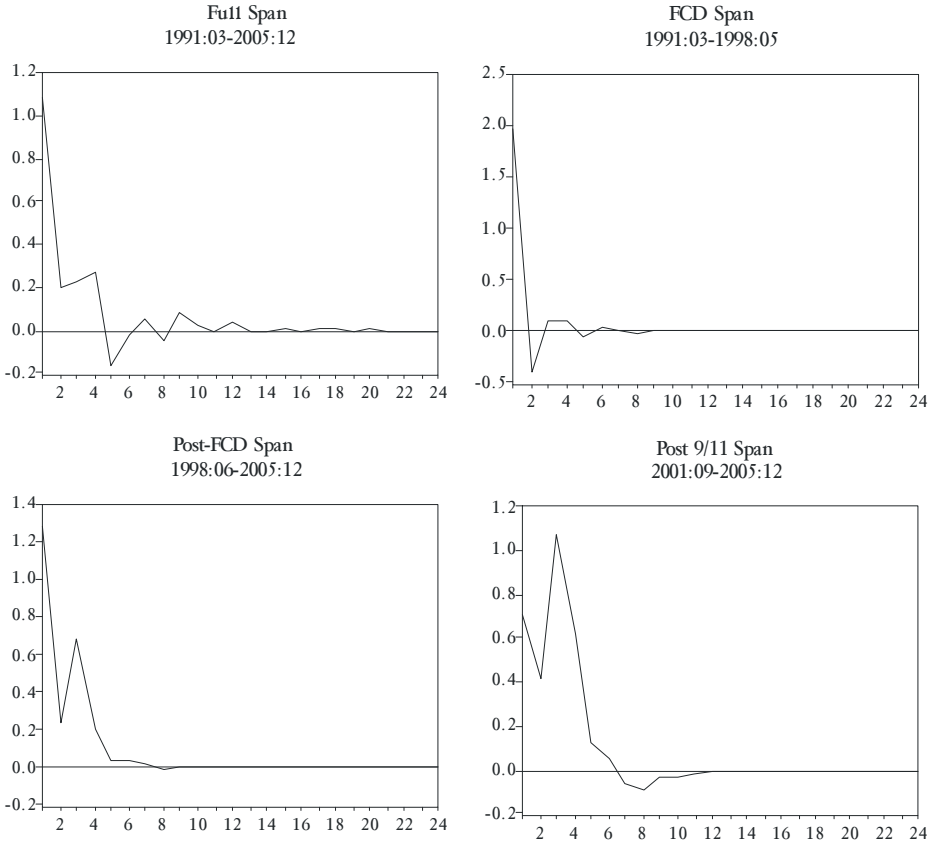
Table-5.2: Shock to: Innovation to Domestic Credit Impact upon: Exchange Market Pressure

Periods	Data Spans			
	Full	FCD	98-05	9/11
1st	1.09	1.99	1.29	0.70
	(5.52)	(7.38)	(5.25)	(2.59)
3rd			0.68	
			(2.56)	

t-statistics in parenthesis

The positive and contemporaneous impact of a shock to domestic credit growth on exchange market pressure is as hypothesized and is in conformity with the monetary approach ' an increase in domestic credit causes the exchange rate to depreciate or the foreign reserves to deplete or some combination of the two, that is, exchange market pressure.

Fig. 5.1
Response Function
Shock to: Innovation to Domestic Credit
Impact upon: Exchange Market Pressure



The monetary approach holds that, given full employment, the newly created domestic credit is spent on the import of goods and services or on acquisition of assets abroad. In Pakistan, outward capital mobility being highly restricted, it is primarily the import of goods and services that causes the response.

5.1.2. Feedback Relation: Effect of Exchange Market Pressure on Domestic Credit:

The relevant IRF's (Table-5.3 and fig. 5.2) for the full data span (91-05) and the sub span that covers the life of FCDs (91-98) depict a positive impact of the shock to exchange market pressure (emp_t) on domestic credit

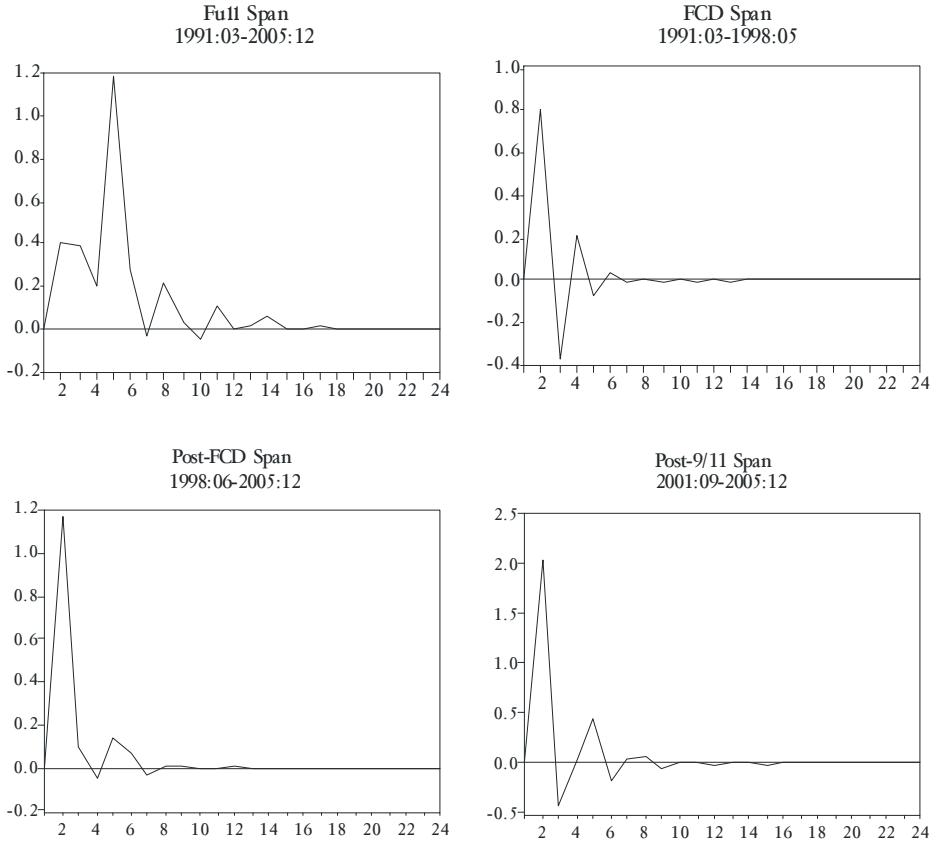
nificant response is noticeable in the post riod and the post 9/11 span.

Table-5.3: Shock to: Innovation to Exchange Market Pressure
Impact upon: Growth in Domestic Credit

	Data Spans			
Period	**Full**	**FCD**	**98-05**	**9/11**
2nd		0.81 (2.18)	nil	nil
5th	1.17 (2.16)			

t-statistics in parenthesis

Fig. 5.2
Impulse Response Functions
Shock to: Innovation to Exchange Market Pressure
Impact upon: Growth in Domestic Credit



f domestic credit growth to a shock to ositive in the first two spans, prudence, however demands just the opposite; that is, the authorities when faced with exchange market pressure (emp_t) should contract the growth rate of domestic credit so as to curb exchange market pressure (emp_t). This should be the response in the light of the prediction of monetary theory and the positive impact of positive domestic credit growth on exchange market pressure observed earlier (Table-5.2).

Despite the response being, *prima-facie*, imprudent as far as controlling exchange market pressure is concerned, the result is in conformity with what others have found for different economies. Tanner (2001, 2002) for Mexico and six East-Asian countries and Bautista and Bautista (2002) for the Philippines also find a positive feedback from exchange market pressure (emp_t) to domestic credit growth (dc_t). Their findings confirm a key element of Mexican and the East-Asian currency crisis, that the authorities sterilized foreign reserves outflow and responded by providing additional liquidity to the banking system. This worsened the already high exchange market pressure [Bautista and Bautista (2002)]. The observed positive response of domestic credit (dc_t) to exchange market pressure shock (emp_t) suggests that authorities in Pakistan too, tend to sterilize foreign reserves outflows on the pattern noticed in the economies referred to above. Perhaps it is the fiscal needs/the urge boost growth that prompted such sterilization.

Another possible explanation offered by Tanner (2001) for East-Asian countries, that could be valid for Pakistan as well, is that the banking sector, when faced with a high probability of loan defaults, tries to minimize their stakes, by offering more credit to the defaulters in the hope of rehabilitating the projects and thereby enabling them to repay the loans. This explanation seems partly true in case of Pakistan as well; the 1990s has seen loan restructuring exercises being undertaken by commercial banks to rehabilitate sick projects. This was done under the auspices of the government/SBP. Besides, the non-recovery of loans by the banks could have led to a liquidity crunch and the central bank, in order facilitate fresh lending, responded with an increase in domestic credit.

To understand the absence of a statistically significant response in the post FCD freeze span (98-05) and post 9/11 span (01-05), note that after 9/11 the foreign reserves registered tremendous improvement and the exchange rate, for the first time in Pakistan's history, was on an appreciation course. The increase in foreign reserves and exchange rate appreciation between September 2001 and December 2003 is given below in Table-5.4.

reciation & Increase in Foreign Reserves

	Sept. 2001	Dec. 2003	Appreciation/Increase
Exchange Rate	Rs. 64.20	Rs. 57.21	12 percent
Foreign Reserves	$ 2,149	$ 10,941	409 percent

Post 9/11 the surge in foreign reserves was due to (i) rescheduling/write-off of foreign debt; (ii) remittance of money by overseas Pakistanis through formal channels instead of the informal channels used earlier[39]; (iii) feeling of insecurity amongst Pakistanis residing in the West and (iv) and return of Pakistanis residing without proper documents in United States.

Given the improvement in foreign reserves and appreciation of the exchange rate, the exchange market pressure remained consistently negative for 27 months (Oct.01-Dec.03). Even during the following two years, the exchange market pressure remained negative for eight out of 24 months. Thus out of the total span of 52 months, the exchange market pressure had remained negative for 35 months - this covers two-thirds of the post 9/11 span. Thus there is reason to believe that monetary policy in the post 9/11 span would be different from the one practiced earlier. Initially the impact was so sudden that in just two months following 9/11, the exchange rate had appreciated by over 5 percent and the foreign reserves had registered an increment of 47 percent.

The appreciation of the exchange rate was hurting the export competitiveness of the country. Besides, events following 9/11 had also adversely influenced exports, at least in the short run. Given this, the authorities purposely slowed down the appreciation of exchange rate to, (i) limit the damage to Pakistan's export competitiveness (SBP 2001)[40] and (ii) to afford time to the exporters to adjust to the changed environment. Consequently the central bank purchased substantial foreign currency from the forex market against domestic currency, thereby increasing domestic credit. The year-wise intervention activity of the central bank is depicted below in Table-5.5.

[39] The change in channel was due to an international crack-down on informal channels of remitting money.

[40] For detailed discussion regarding the favorable impact of 9/11 on Pakistanôs external account see SBP annual report (2001, pp. 54-60). For monetary policy put into practice to factor in the new developments see pp. 79-80 of the same report.

Sale of Foreign currency by SBP

($ in million)

Period	Interbank (net)	Kerb Purchases	Net Addition to Foreign Reserves
1999-2000	-797.0	1,633	836
2000-2001	-1,126	2,157	1,031
2001-2002	2,483	1,376	3,859
2002-2003	4,546	429	4,975
2003-2004	897	-	897

Note: The negative sign with the figures indicates sale of foreign currency

Source: SBP annual reports (Various issues)

Thus to maintain competitiveness of the country's exports, domestic credit was increased consequent upon a fall in exchange market pressure (SBP 2002-03, p.144 & 163). Given the foregoing explanation, the innovation to the exchange market (decrease in this case) should have generated a negative response (increase in this case) from domestic credit during the sub-spans 'post FCD-freeze' and 'post 9/11'. The question then arises why a 'nil' rather than negative response is observed. The answer lies in sterilization of the intervention activity referred above. For illustrative purpose the sterilization activity, of the State bank, during 2001-02, is indicated in Table-5.6.

Table-5.6: Sterilization in 2001-02

(RS. In billions)

		Impact on SBP	
		NFA	NDA
1	Interbank US $ purchases (net)	150	
2	Kerb Purchases	84	
3	Government borrowing from commercial banks (RS. 160.4 billion)		
4	Retirement of Government securities with SBP		-287
5	Net Impact	234	-287
6	Net impact on Reserve Money (Domestic Credit)		-53

NFA: Net foreign Assets NDA: Net Domestic Assets

...th of RS.234 billion due to the purchase of ... by the State Bank was more than offset by the retirement of government borrowing from SBP (Table-5.6 ' serial no. 6). Thus the intervention activity in 2001-02 was completely sterilized. Similarly, out of the foreign currency purchased worth RS.291 billion in 2002-03, RS.206 million was sterilized (SBP 02-03, p. 79). It is because of this kind of sterilization that, despite the huge foreign currency purchases against domestic currency, no significant response is observed during the post 9/11 span from exchange market pressure to domestic credit.

5.1.3. Shock to Interest Rate: Impact upon Exchange Market Pressure

The statistically significant responses of exchange market pressure (emp_t) to an interest rate shock are reported below (Table-5.7 and fig. 5.3):

Table-5.7: Shock to: Innovation to Interest Rate

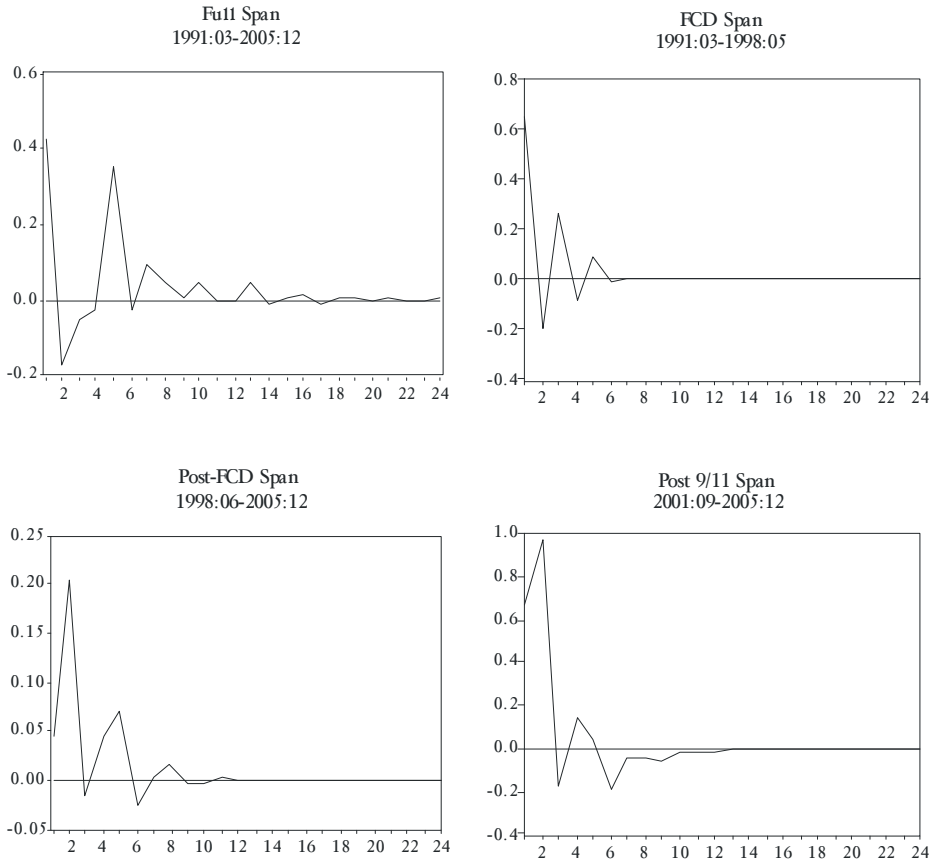
Impact upon: Exchange Market Pressure

Period	Data Spans			
	Full	FCD	98-05	9/11
1st	0.43	0.66		0.67
	(2.28)	(3.06)	nil	(2.61)
2nd				0.97
				(2.89)

Note: t-statistics in parenthesis

The impact of a shock to the interest rate on exchange market pressure is, as hypothesized, positive in all the data spans. No statistically significant response is observed in the span 98-05. First, we take up the positive response observed in the two sub spans, that is the FCD span and the post 9/11 span and then we move on to the positive response observed in the full span and the absence of response in the span 98-05 — the post FCD-freeze span.

Fig. 5.3
Response Function
Shock to: Innovation to Interest Rate
Impact upon: Exchange Market Pressure



The positive influence of the interest rate on exchange market pressure during the FCD span (1991:04-1998:05) can be explained in terms of the theory of money demand and the change in attractiveness of domestic securities *vis-a-vis* international securities. The following flow chart explains the channel through which FCDs might have influenced exchange market pressure consequent upon shock to interest rate:

Increase in interest rate decrease in money demand exchange rate depreciation increase in yield on FCDs increase in FCDs volume change in exchange market pressure

or the impact of an interest rate shock on ven in the foregoing flow chart, is that the increase in the interest rate reduced money demand that in turn caused the exchange rate to depreciate. It is noteworthy that the total yield on foreign currency deposits (FCDs) comprised the interest earned on FCDs plus the exchange rate depreciation. The higher the exchange rate depreciation, the greater the yield on FCDs. As the exchange rate depreciation caused the yield on FCDs to increase, the depreciation contributed to an increase in the volume of FCDs with commercial banks. The surrender of foreign currency thus mobilized by banks to SBP increased foreign reserves thereby contributing to a decline in exchange market pressure. However on the other hand exchange rate depreciation contributed to the increase in exchange market pressure.

Given the positive as well as negative impact of FCDs on exchange market pressure, the authorities had a dilemma at hand. The fact that (by and large) the interest rate, during the FCD span, maintained an upward course and the ultimate response of exchange market pressure to an interest rate shock is positive (i.e. increase) suggests that the alleviation impact due to increases in foreign reserves was more than offset by the exchange rate depreciation. (During the span the interest rate recorded an increment of 744 basis points while the exchange rate depreciated by 87 percent ' Table-5.8). The view is corroborated by the SBP annual report 1997-98 that warns the government of the negative implications of FCDs[41].

Table-5.8: Exchange Rate Appreciation & Increase in Interest Rate

	April 1991	May 1998	Increase/ Depreciation
Interest Rate	8.80 %	16.24 %	744 basis points
Exchange Rate	23.50	44.05	87 percent

This brings us to the question of why the government persisted with the scheme if the net impact of the scheme on exchange market pressure was negative. The ensuing analysis provides the answer. The import coverage ratio, that measures the country's ability to meet its imports from forex reserves alone, is one measure used to determine the safe/optimal level of foreign reserves. The import coverage ratio that prevailed during the FCD span is shown below (Table-5.9).

[41] SBP annual report 1997-98, pp. 109-23

eserves as Percentage of Imports

Year	Imports ($ in billions)	Reserves (12-Month avg.) ($ in billions)	Import coverage (Avg. Resv*. as % of imports)
90-91	8,325	366	4.27
91-92	8,998	534	5.39
92-93	10,049	808	8.04
93-94	8,685	1,186	13.66
94-95	10,296	2,642	25.66
95-96	12,015	1,626	13.53
96-97	11,241	1,040	9.25
97-98	10,301	1,268	12.31

*Avg. of reserves at the beginning and end of the year.

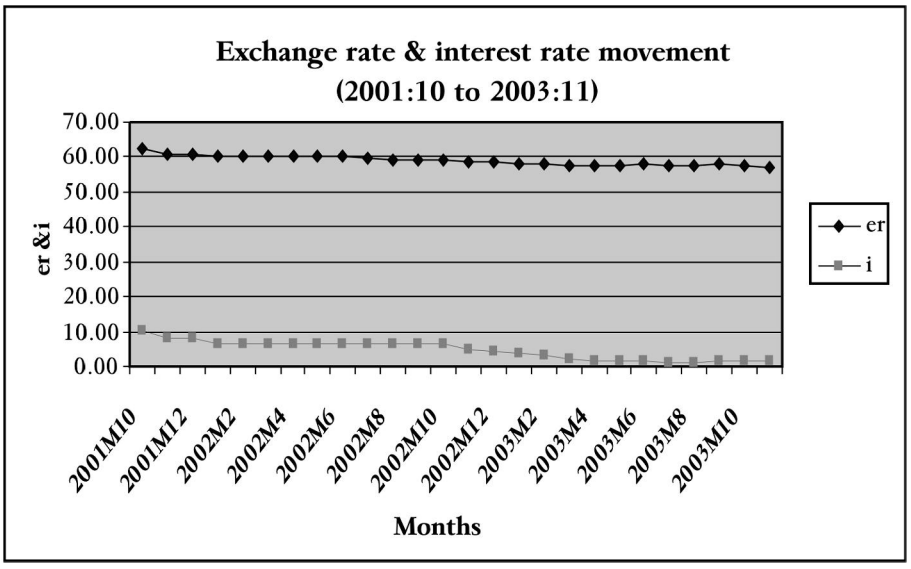
Assuming that foreign reserves volume of less than 12 weeks of imports (i.e. 25 percent of annual imports) reflects a crisis-like situation, then it is evident from Table-5.9 that during the entire FCD-span, the reserves held were precariously low in relation to imports and only once did these barely crossed the danger mark of 25 percent of imports. Another indicator of foreign reserves adequacy is the *Guidotti rule*, which says that reserves should be enough to meet scheduled external debt payments as well as the projected current account deficit (excluding interest payments) for the next 12 months. On this criterion, as well, Pakistan did not have enough reserves at the beginning of any fiscal year till 2002-03 (SBP 2002-03, p. 162).

It was this low level of foreign reserves that forced the government to continue with the FCD scheme and embrace the vicious cycle of *interest rate hike-exchange rate depreciation*. Hence the positive response of the interest rate to a shock to exchange market pressure during the FCD span. It appears that it is the FCDs channel, described above that has been operative during the span. The view gains substance from the opinion that post FCD-freeze span (98:06-05:12) does not exhibit any impact of an interest rate shock on exchange market pressure (Table-5.7).

impact of the interest rate on exchange 9/11 span, an entirely different explanation is in order than the one given for the FCD span.

Post 9/11, the movement of the interest rate and exchange market pressure can be studied in two distinct parts. One; the period from 2001:09 to 2003:12 when the exchange rate was appreciating (8 percent appreciation), foreign reserves were on the rise and the interest rate declined by 929 basis points. Second; the period from 2004:01 to 2005:12 when the exchange rate was depreciating (5% depreciation) and interest rate was on the rise: (704 basis points increase)[42]. The positive relationship observed between the movements in the exchange rate and the interest rate during the two periods is depicted in fig. 5.4 and fig. 5.5

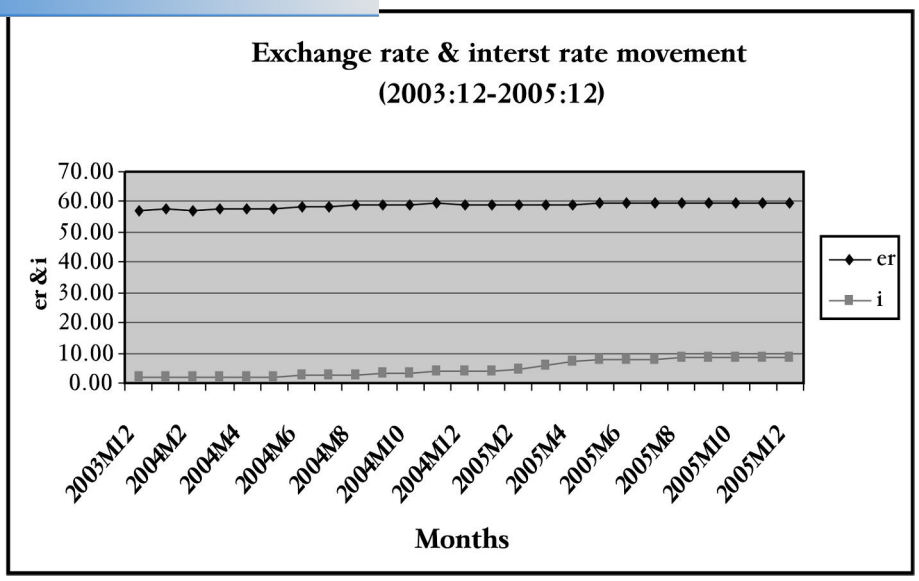
Figure 5.4



It is evident from fig. 5.4 that from 9/11 till December 2003 the interest rate was declining and the exchange rate was on an appreciation course, thus representing the positive relationship between the two. Starting from January 2004 the interest rate set on an upward course and the exchange rate also broke its appreciation spell to set on a depreciation course once again. (Fig 5.5) The positive relationship shown in two figures is in conformity with the theory and is as hypothesized.

[42] For the econometric analysis, the post 9/11 span has not been broken further into two sub-spans because that would have reduced the sample size to 28 months and 24 months respectively ' a sample size not large enough for reliable econometric investigation.

Figure 5.5



5.1.4. Feedback Relation: Effect of Exchange Market Pressure on Interest Rate

The statistically significant responses of the interest rate (i_t) to a shock in exchange market pressure (emp_t) are noted below (Table-5.10 and fig. 5.6).

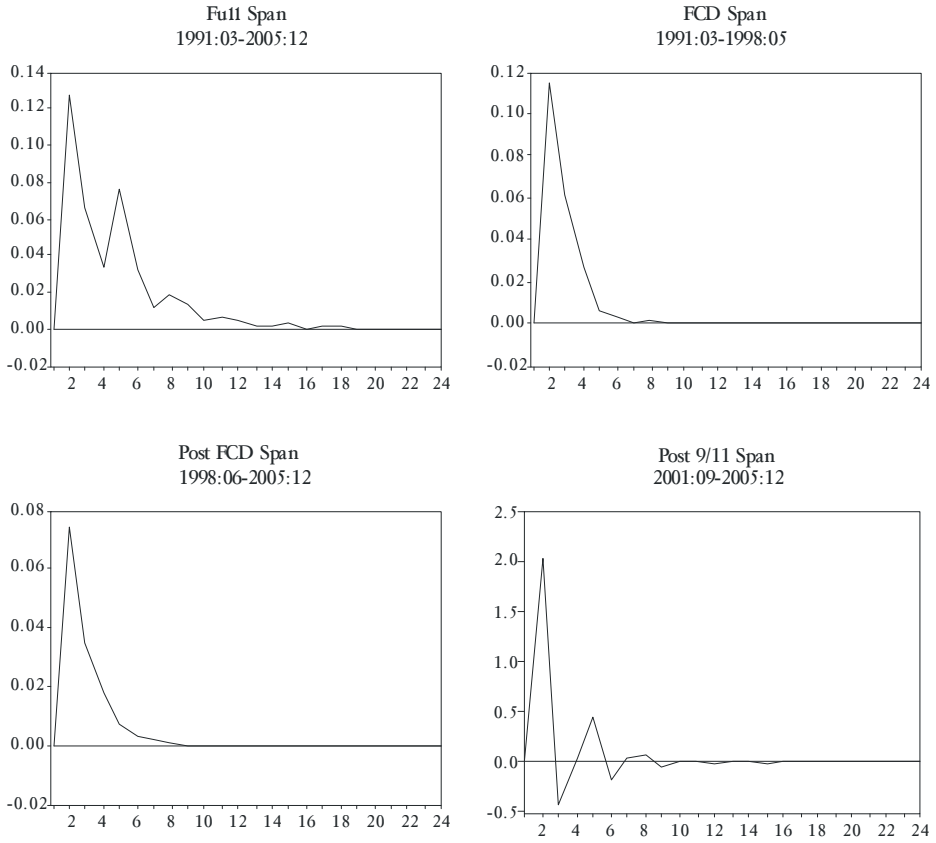
Table-5.10: Shock to: Innovation to Exchange Market pressure
Impact upon: Interest Rate

Period	Data Spans			
	Full	FCD	98-05	9/11
1st				0.07*
				(1.66)
2nd	0.13	0.12	0.07*	
	(3.70)	(2.40)	(1.68)	
3rd				0.07*
				(1.64)
5th	0.08			
	(2.26)			

Note: t-statistics in parenthesis

Significant at 10 percent level

Fig. 5.6
Response Function
Shock to: Innovation to Exchange Market pressure
Impact upon: Interest Rate



The positive feedback from exchange market pressure to the interest rate is observed in all the data spans (Table-5.10). First we examine the response during the FCD span and then take up the responses in post-freeze and post 9/11 span.

Explanation for the positive feedback from exchange market pressure to the interest rate is found in what the literature labels 'interest rate defense of exchange rate' (Flood & Jeanne, 2000, Tanner, 2002). Under this strategy the authorities, when faced with exchange market pressure, respond with influencing a hike in domestic interest rate. Given the international rate, the increase in the domestic interest rate encourages capital inflows and vice versa, provided capital mobility conditions are fulfilled.

od decade for the external account scenario jor source, *viz.* remittances from overseas Pakistanis, had been on a declining course since 1983 (1981-82: $2.9 billion, 1999-00: $0.98 billion). Besides, the international geo-political environment being not too favorable, foreign lending, bilateral as well as multilateral, was scanty and even that was available only on harsh terms. Given this scenario, the authorities, in March 1991, allowed residents to hold Foreign Currency Deposits (FCDs) with commercial banks. The deposit accounts were frozen in May 1998[43]. During this period, as the exchange market pressure was relatively high the authorities might have purposely influenced an upward movement in interest rate to attract deposits in foreign currency accounts. Regarding the high *emp* it is noteworthy that during this span, the exchange rate depreciated by 87 percent (Table-5.7) and except for FY 94-95 foreign reserves covered imports merely to the extent of 14 percent or even less (Table-5.10).

Another possible explanation for the hike in the interest rate, during the major part of the '90s in response to the shock to exchange market pressure can be found in the ***dollarization*** phenomena. As economic agents purchased foreign currency from the kerb market for holding FCDs, the additional demand for foreign currency in the kerb market caused the Rupee to depreciate and improved the FCDs' yield (interest on deposits plus exchange rate depreciation), but the depreciation also contributed to inflation and to control inflation the authorities had to respond with the increment in the interest rate. Whatever the mechanics, an important piece in the cycle leading to the interest rate hike is the exchange rate depreciation, which is a component of exchange market pressure. Hence the positive feedback from the interest rate to exchange market pressure.

Given the polar objectives of encouraging FCDs (as these contributed to the increment in foreign reserves) through ***dollarization*** and controlling inflation, the authorities had a dilemma at hand. Given the dilemma the authorities went for the vicious circle of ***exchange market pressure-interest rate hike.*** The vicious circle went on during the seven year life of FCDs; however its impact seems so pronounced that the positive impact of emp_t on i_t is observed even when the full span of 14.9 years is

[43] The freeze on FCDs meant that, against the terms of the contract, account holders were allowed to withdraw only the Rupee equivalent against the money in foreign currency that they had deposited. This had shattered the confidence of the depositors and inflows into the account almost stopped, thereby reducing the demand for foreign currency in the kerb market and contributing to *de-dollarization*.

xchange rate depreciation and interest rate
wn in Table-5.8.)

The positive impact of (emp_t) on (i_t) for the span 1998-05 and 2001-05 is accounted for in the following manner: The positive feedback from exchange market pressure to the interest rate during the post-FCD freeze span can be studied in two distinct parts, that is the pre 9/11 and post 9/11 period. The first shock, during the span, came as the multilateral/bilateral lending agencies imposed aid sanctions on Pakistan as the country went nuclear in May 1998. The second shock occurred with 9/11. Four measures undertaken in the wake of aid-sanctions led to a decrease in exchange market pressure. These include: (i) freeze on foreign currency accounts; (ii) introduction of a two tier exchange rate in July 1998 and a pure float in May 1999; (iii) rationing of imports; and (iv) Saudi Oil facility. The impact of these measures on exchange market pressure is discussed below.

We have argued earlier in this section that FCDs had led to *dollarization* and in section 5.1.3, and that the net impact of FCDs seemingly caused a persistent increment in exchange market pressure. With the freeze on these deposits, *dollarization* and hence the exchange rate depreciation on this count came to a halt and therefore the pressure declined.

The two-tier exchange rate, introduced on July 22, 1998, required conducting the transactions involving foreign exchange at a composite rate, which was based on a certain specified ratio (initially 50:50) of the official rate (announced by SBP) and floating interbank rate (determined on the basis of demand and supply of foreign currency in the interbank market). Except for certain specified goods that were allowed to be imported at official rate, the rest of trade was done only at the composite rate. Following the aid-sanctions/FCD-freeze, for the following 10 months (June 98-April 99) the exchange rate was held static at Rs. 46 to one dollar. The Rupee was devalued by 12.3 percent in May 1999 to attain a value of Rs. 51.69 and was then held static again around this level for yet another 16 months, that is, until August 2000. The interbank rate on the other hand continued to depreciate in line with market conditions.

Thus though the official rate was held static for sufficient length of time, the introduction of the composite rate, that depended on interbank rate as well, had in fact meant the *de facto* devaluation of Rupee. It was this *de facto* devaluation, which was fairly large, that had discouraged imports and therefore led to a reduction in the trade deficit. Besides, some rationing of imports in the initial period, after the emergence of crisis, had also

the trade deficit. The reduction, in turn, ket pressure. Finally, the Saudi oil facility, negotiated after the aid-sanctions, allowed the country to import a major chunk of its oil needs for credit. This, by reducing the outflow of foreign currency, also served to contain exchange market pressure. It was the combined effect of the four measures discussed above that exchange market pressure on average declined, despite the aid sanctions and the freeze on FCDs in two years (i.e. 98-99 and 99-00) following aid sanctions/FCD freeze (Table-5.11).

Table-5.11: Trade deficit & Exchange Market Pressure

($ in millions)

	Year					
	1997-98	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**
Trade Deficit	-1,867	-2,085	-1,412	-1,269	-294	-536
Exports	8,434	7,528	8,190	8,933	9,140	10,889
Imports	-10,301	-9,613	-9,602	-10,202	-9,434	-11,425
emp_t (Avg.)*	1.34	0.07	0.34	1.7	-3.6	-4.2

While analyzing the feedback from exchange market pressure to the interest rate, we had indicated that the relatively high exchange market pressure in the FCD span had forced the authorities to adopt interest rate defense of the exchange rate. Now that the pressure declined, the need for such defense was no longer there and hence the decline in the interest rate consequent upon the decrease in exchange market pressure.

Regarding the positive feedback from the interest rate to exchange market pressure during the second part of the span, that is the post 9/11 span, again we had discussed earlier (in section 5.1.2) that post 9/11 for 35 months out of the 53 months span, the exchange market pressure remained not only low but even negative. Given the low pressure, the need for defending the Rupee was not there and this allowed the SBP to reduce the interest rate that otherwise was also required to give a boost to economic activity. The following statements emanating from SBP confirm the point.

> Improvement in the external sector also had a major impact on SBP policies ---- the absence of pressures on the exchange rate allowed SBP to reduce the Bank discount rate. (SBP Annual report 2001-02, p. 156).

lows ---- during FY03 allowed, the unt rate to an all-time low at 7.5 percent in November 2002. (SBP Annual report 2002-03, p. 147).

The foregoing discussion explains how the low exchange market pressure during the post-FCD freeze span and the post 9/11 span contributed to the decline in the interest rate. This accounts for the positive impact, during the two spans, of the shock to exchange market pressure on the interest rate.

5.2 Sensitivity Analysis

As indicated earlier under the theoretical framework, VAR results are sensitive to *ordering* of variables of the system. To guard against the possibility of *ordering*-based result, the results have been checked against sensitivity to *ordering*. The main *ordering* used in this study is [*dc-i-y-emp*]. Significant IRF's for the full data span under some alternate *orderings* are presented in Table-5.12.

Table-5.12: Sensitivity to Ordering of variables

Shock to innovation to:	Impact upon	Period	Ordering Used dc-i-y-emp	Alternate Orderings		
				dc-i-emp-y	*dc-emp-i-y*	*emp-dc-i-y*
dc_t	emp_t	Ist	1.09	1.08	1.08	0.35
			(5.52)	(5.53)	(5.52)	(1.74)
emp_t	dc_t	Ist				3.86
						(5.53)
		5th	1.17	1.33	1.48	
			(2.16)	(2.41)	(2.65)	
i_t	emp_t	Ist	0.43	0.43	0.27	0.27
			(2.28)	(2.28)	(1.70)	(1.72)
emp_t	i_t	Ist			0.10	0.11
					(2.28)	(2.60)
		2nd	0.13	0.14	0.16	0.16
			(3.70)	(3.88)	(4.23)	(4.13)
		3rd			0.08	0.09
					(2.16)	(2.39)
		5th	0.08	0.07		0.10
			(2.26)	(2.08)		(2.63)

It is apparent from the Table-5.12 that the results are, by and large, robust. The *ordering* that has emp_t in the first place (and thus prior to dc_t) alters the coefficients significantly however the change in *Ordering* only affects the size of the coefficients; the direction of response remains unaffected.

6. Conclusion

Exchange market pressure represents disequilibrium in the money market. This study, in the spirit of Girton and Roper (1977) takes the view that since a managed float involves changes in the exchange rate as well in variation in foreign reserves, to study disequilibrium in the money market/characterize the external account, we need to focus upon a composite variable that incorporates changes in foreign reserves as well as variation in the exchange rate. Following Girton and Roper we refer to the composite variable thus developed as exchange market pressure.

We developed a time series of exchange market pressure in accordance with the definition of Girton and Roper to examine the interaction of the monetary variables *viz.* domestic credit and the interest rate with the exchange market pressure. Innovation to domestic credit, as well as to the interest rate, generates a positive response from exchange market pressure. Both the results are in conformity with the theory. The impact of domestic credit is much stronger (i.e. the size of the coefficients is relatively larger), as compared to the interest rate, and the impact of domestic credit is observed in all the data spans examined while the impact of interest rate on exchange market pressure is not observable in the post-FCD freeze span (1998:06-2005:12). The two findings together imply that domestic credit has been the dominant tool of monetary policy ***vis-a-vis*** managing exchange market pressure. Our results also show that post 9/11, given the unexpected and sharp decline in exchange market pressure, domestic credit was actively used to manage the pressure, so as to avoid a larger adverse impact on export competitiveness. The intervention was largely sterilized to protect the economy from the inflationary impact of an increase in money supply.

Feedback from exchange market pressure to domestic credit is positive in all the data spans examined. The response, though against conventional wisdom, is in conformity with the findings of previous studies. The apparent reason for the imprudent response lies in monetary policy being influenced by; (i) fiscal needs, (ii) the eagerness to boost growth (iii)

quidity crunch created from the default on create additional liquidity to revive the sick industries.

FCDs had provided some inward capital mobility (1991-98). The observance of a response from the interest rate to exchange market pressure, though a weaker one in the pre-freeze period and absence of the same in post-freeze period, serves to emphasize that for the interest rate to work as a tool of monetary policy, ***vis-a vis*** exchange market pressure, a reasonable degree of capital mobility is called for.

The feedback relation from exchange market pressure to the interest rate is also positive and is observed in all the data spans examined. For the FCD span, the response implies an interest rate defense of the exchange rate. The purpose of this is to control inflation, stemming from exchange rate depreciation, that itself was due to ***dollarization***. Post FCD-freeze/post 9/11 ***dollarization*** came to a halt for (i) want of avenues (FCDs that served as avenues were frozen) and (ii) due to a dramatic improvement in the external account; therefore the need to defend the Rupee vanished. Therefore there was a decrease in the interest rate in response to the decrease in exchange market pressure.

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Annexure A

Reserve Money being composed of domestic and foreign components, the domestic credit is worked out as the difference between total Reserve Money and the foreign component of Reserve Money. The foreign component is obtained by multiplying the month-end foreign reserves outstanding with the relevant month-end nominal exchange rate. To work out the Domestic Credit in the manner referred above, we need data on the following series.

- Reserve Money
- Foreign Reserves
- Nominal Exchange rate

Exchange Market Pressure

Exchange market pressure (*emp*), defined as sum of exchange rate depreciation and foreign reserves outflow scaled by monetary base (Reserve money) requires data on the following:

- Nominal exchange rate
- Foreign Reserves
- Reserve Money

The data required for generating the Exchange market pressure series is exactly the same as required for generating domestic credit series.

Deviation from Purchasing Power Parity

As explained earlier under theoretical framework deviation from purchasing power parity (PPP) is to be worked out as per equation (A-1) which after slight algebraic manipulation is reproduced below for ready reference.

$$z_t = e_t + \pi_t^* - \pi_t \qquad \text{(A-1)}$$

To generate the series 'Deviation from PPP' (z_t) we need data on the following:

- Nominal exchange rate
- International price level (Proxy: US CPI)
- Domestic price level (CPI)

Estimating and Forecasting Volatility of Financial Time Series in Pakistan with GARCH-type Models

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Abstract

In this paper we compare the performance of different GARCH models such as GARCH, EGARCH, GJR and APARCH models, to characterize and forecast financial time series volatility in Pakistan. The comparison is carried out by comparing symmetric and asymmetric GARCH models with normal and fat-tailed distributions for the innovations, over short and long forecast horizons. The forecasts are evaluated according to a set of statistical loss functions. Daily data on the Karachi Stock Exchange (KSE) 100 index are analyzed. The empirical results demonstrate that the use of asymmetry in the GARCH models and the assumption of fat-tail distributions for the innovations improve the volatility forecasts. Overall, EGARCH fits the best while the GJR model, with both normal and non-normal innovations, seems to provide superior forecasting ability over short and long horizons.

Keywords: APARCH; EGARCH; Fat-tailed distribution; Forecast; Forecast horizon; GARCH; GJR; KSE 100; Volatility.

Introduction

Financial markets play a crucial role in any country's economy. Monetary policies are generally based on stock exchange indices, foreign exchange rates, price indices, inflation rates, interest rates, etc. Further it is generally assumed that the ultimate goal for monetary policy is price stability. Empirical studies have concluded that a large change in prices

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a larger change in the financial sector for to be conducted. One has to carry a time series study of all such financial changes. Some well-known characteristics are common to many financial time series. Even a cursory look at data suggests that some time periods are riskier than others resulting in a variation in the expected values of the error terms. Moreover, these risky times are not scattered randomly across quarterly or annual data. Instead, there is a degree of autocorrelation in the riskiness of financial returns. Volatility clustering is often observed. Financial time series often exhibit leptokurtosis, meaning that the distribution of their returns is fat-tailed. Moreover, the so-called leverage effect refers to the fact that changes in stock prices tend to be negatively correlated with changes in volatility. The econometric challenge is to specify how the information is used to estimate and forecast the mean and variance of the return, conditional on the past information. Currently the most powerful known techniques used to estimate and predict the volatility on high frequency data belong to a family of generalized conditional autoregressive heteroskedastic (GARCH) models. The goal of such models is to provide a volatility measure like a standard deviation that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing.

Primarily, time varying heteroskedasticity is modeled by Engle (1982). He proposed the autoregressive conditional heteroskedastic (ARCH) process that allows the conditional variance to change over time as a function of past errors leaving the unconditional variance constant. Bollerslev (1986) extended his work and introduced the generalized autoregressive conditional heteroskedastic (GARCH) process. These models have been proved useful for modeling a variety of time series phenomena. However, both the models only control for the conditional heteroskedasticity, but they do not capture the so-called leverage effect. This led to the extension of nonlinear GARCH models e.g., the exponential GARCH (EGARCH) by Nelson (1991), GJR by Glosten, Jagannathan and Runkle (1993), the asymmetric power ARCH (APARCH) by Ding, Granger and Engle (1993), the Threshold GARCH of Zakoian (1994), the Quadratic GARCH (QARCH) by Santana (1995), etc. Although asymmetric models successfully capture the leverage effect, under the assumption of normal distribution of the innovation, they fail to capture the thick tail properties of financial time series. This has naturally led to the use of non-normal distributions, such as student-t, generalized error, normal Poisson, normal-lognormal, Bernoulli-normal, and skewed student-t distributions (see Peters, 2001 and the references therein).

...ance of GARCH models has been assessed ...wert (1990), Brailsford and Faff (1996) and ...Loudon, Watt and Yadav (2000). On the other hand, comparing normal densities with non-normal ones, has also been studied in several times e.g., see Hsieh (1989), Baillie and Bollerslev (1989), Peters (2001) and Lambert and Laurent (2001).

The main goal of present study is to evaluate the performance of different GARCH models in terms of their ability to characterize and predict out-of-sample volatility of financial time series in Pakistan. For this purpose, we compare the forecasting ability of GARCH, EGARCH, GJR and APARCH models with normal, student-t and generalized error distribution (GED) innovations. The forecasting performance of such models is assessed through statistical loss functions. The estimates and forecasts are made on the KSE 100 index, because Pakistan's KSE 100 index is the best-performing stock market index in the world.

The plan of the paper is as follows: Section 2 discusses the models used in the study. Section 3 briefly describes the densities. In Section 4 we discuss forecast evaluation methods in terms of the statistical loss function to assess the forecast ability. All the empirical results and discussions are presented in Section 5 and some concluding remarks are made in Section 6.

2. Volatility Models

2.1. The GARCH Process

Let y_t denote the price index at time t =1, 2, ..., T and $r_t = ln(y_t / y_{t-1}) \times 100$ denote the rate of return from time t to t-1. Let ε_t be a real valued discrete - process and Ψ_t the information set (σ -field) of all information through time t. The ARMA(k, l)-GARCH (p, q) process is then defined as in (1)-(2)

$$r_t = \phi_0 + \sum_{i=1}^{k} \phi_{t-i} r_{t-i} + \sum_{j=1}^{l} \theta_{t-j} \varepsilon_{t-j} + \varepsilon_t \quad , \tag{1}$$

$$\varepsilon_t / \Psi_{t-1} \sim N\left(0, \sigma_t^2\right),$$

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^{q} \gamma_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \omega_j \sigma_{t-j}^2 \quad , \tag{2}$$

$\gamma_i \geq 0$ for all $i = 1, 2, ..., q$ and $\omega_j \geq 0$ the GARCH (p, q) process reduces to the ARCH (q) process and the conditional variance is simply a linear function of the past squared innovations only. If $p = q = 0$ then the GARCH process is simply white noise with constant unconditional variance. The GARCH process defined in (1) is stationary

$$\text{iff} \quad \sum_{i=1}^{q} \gamma_i + \sum_{j=1}^{p} \omega_j < 1$$

Under the GARCH (p, q) process, the one-step-ahead volatility forecast may be given as

$$\hat{\sigma}^2_{T+1/T} = \hat{\gamma}_0 + \sum_{i=1}^{q} \hat{\gamma}_i \varepsilon^2_{T+1-i} + \sum_{j=1}^{p} \hat{\omega}_j \hat{\sigma}^2_{T+1-i}.$$

2.2. EGARCH Model

The exponential GARCH or EGARCH model involves the first introduction of an asymmetric effect on negative and positive shocks in an econometric model of volatility, by Nelson (1991). The specification for such a model is given as

$$ln\sigma_t^2 = \gamma_0 + \sum_{i=1}^{q} (\gamma_i |\eta_{t-i} - E(\eta_{t-i})| + \beta_i \eta_{t-i}) + \sum_{j=1}^{p} \omega_j \sigma^2_{t-j},$$

where $\eta_t = \dfrac{\varepsilon_t}{\sigma_t}$ is the standardized normal residual series.

The formulation in logarithm shares the usual positivity constraints on the parameters and also implies that the leverage effect is exponential rather than quadratic. The asymmetric effect is introduced by the non-linear function $\gamma_i |\eta_{t-i} - E(\eta_{t-i})| + \beta_i (\eta_{t-i})$ which is the function of both the magnitude and the sign of η_t. This specification has another advantage as compared to other asymmetric GARCH models; that is, it does not require any stationary constraints.

One step-ahead conditional variance forecast may be given as

$$\left. - E(\eta_{T+1-i})\right| + \hat{\beta}_i \eta_{T+1-i}) + \sum_{j=1}^{p} \hat{\omega}_j \hat{\sigma}^2_{T+1-i} \Bigg)$$

2.3. GJR Model

Glosten, Jagannathan and Runkle (1993) also consider the impact of good and bad news by introducing indicator function in the symmetric GARCH model

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^{q} (\gamma_i \varepsilon_{t-i}^2 + \beta_i d_{t-i} \varepsilon_{t-i}^2) + \sum_{j=1}^{p} \omega_j \sigma_{t-j}^2 \ ,$$

where d_t is the dummy variable and takes the value 0 when ε_t is positive and 1 when ε_t is negative. In other words the impact of ε_t^2 on the conditional variance is different when ε_t is positive or negative.

The one-step-ahead volatility forecast for the GJR model may be given as

$$\hat{\sigma}^2_{T+1|T} = \hat{\gamma}_0 + \sum_{i=1}^{q} (\hat{\gamma}_i \varepsilon^2_{T+1-i} + \hat{\beta}_i d_{T+1-i} \varepsilon^2_{T+1-i}) + \sum_{j=1}^{p} \hat{\omega}_j \hat{\sigma}^2_{T+1-j} \ .$$

2.4. APARCH Model

The GARCH (p, q) model has been extended in various ways. Among the most interesting developments are the asymmetric power GARCH and APARCH (p, q) model (Ding, Granger and Engle, 1993), which allows to take account of both asymmetry and (possible) long memory property. The APARCH model can be expressed as

$$\sigma_t^{\delta} = \gamma_0 + \sum_{i=1}^{q} \gamma_i (|\eta_t| - \beta_i \eta_t)^{\delta} + \sum_{j=1}^{p} \omega_j \sigma_{t-j}^{\delta} \ ,$$

where $p \geq 0$, $q > 0$, $\gamma_0 > 0$, $\gamma_i \geq 0$, $-1 < \beta_i < 1$ for all $i = 1, 2, \ldots, q$, $\omega_j \geq 0$ for all $j = 1, 2, \ldots, p$ $\delta > 0$.

The covariance stationary condition for the model is

$\omega_j < 1$.

Ding, Granger and Engle (1993) found that the closer δ is to 1, the larger is the memory of the process. Equivalently, this model couples the flexibility of a varying exponent with an asymmetry coefficient. Moreover, the APARCH model includes seven other ARCH extensions as special cases (see, Peter, 2001, for more details).

One step-ahead volatility forecast may be given as

$$\hat{\sigma}^{\delta}_{T+1|T} = \hat{\gamma}_0 + \sum_{i=1}^{q} \hat{\gamma}_i (|\varepsilon_{T+1-i}| - \hat{\beta}_i \varepsilon_{T+1-i})^{\delta} + \sum_{j=1}^{p} \hat{\omega}_j \hat{\sigma}^{\delta}_{T+1-j} .$$

3. Densities

A normal density for innovation was assumed in the ARCH process introduced by Engle (1982) and Bollerslev (1986) who extended the ARCH process into GARCH. Although the normal distribution is widespread, it cannot effectively describe the thick tails of stock returns, due to excess kurtosis. Bollerslev and Wooldridge (1992) proposed quasi-maximum likelihood (QML) procedure which is robust to departures from normality. Although the QML estimator is consistent, it is inefficient for non-normality distributed data as the degree of inefficiency increases with the degree of departure from normality (Engle and Gonzalez-Rivera, 1991). This leads to the use of other distribution functions, such as the student-*t* by Bollerslev (1987) and generalized error distribution (GED) by Nelson (1991) to model tail thickness by a parameter, called degree of freedom.

3.1. Standardized Student-t Distribution

Bollerslev (1987) proposed the standardized student-*t* distribution with $\upsilon > 2$ degrees of freedom,

$$f(\eta_t) = \frac{\Gamma((\upsilon+1)/2)}{\Gamma(\upsilon/2)\sqrt{\pi(\upsilon-2)}} \left(1 + \frac{\eta_t^2}{\upsilon-2}\right)^{-\frac{\upsilon+1}{2}} ,$$

where $\Gamma(.)$ is the gamma function. The degree of freedom represents the parameter to be estimated. The *t*-distribution is symmetric around zero and for $\upsilon > 4$ the conditional kurtosis equals $3(\upsilon-2)(\upsilon-4)^{-1}$, which exceeds

$\to \infty$ the density of standardized student-*t* ...ensity function of the standardized normal distribution.

3.2. Generalized Error Distribution

Nelson (1991) suggested the use of the generalized error distribution (GED)

$$f(\eta_t) = \frac{\upsilon \exp(-0.5|\eta_t / \lambda|^{\upsilon})}{2^{(1+\frac{1}{\upsilon})}\Gamma(\upsilon^{-1})\lambda} \qquad \upsilon > 0,$$

where υ is the tail-thickness parameter and $\lambda \equiv \left[2^{(-2/\upsilon)}\Gamma(1/\upsilon)/\Gamma(3/\upsilon)\right]^{1/2}$. When $\upsilon = 2$, η_t is standard normally distributed. For $\upsilon < 2$, the distribution of η_t has thicker tails than the normal distribution (e.g., for $\upsilon = 1$, η_t has double exponential distribution) while for $\upsilon > 2$ the distribution of η_t has thinner tails than the normal distribution (e.g., for $\upsilon = \infty$, η_t has a uniform distribution on the interval $(-\sqrt{3}, \sqrt{3})$ (see Nelson, 1991). The conditional kurtosis is given by $(\Gamma(1/\upsilon)\Gamma(5/\upsilon))/(\Gamma(1/\upsilon))^2$.

Notice that the choice of a density has a particular impact on some models, for example in EGARCH the value of $E|\eta_t|$ depends on the density function for the standard normal distribution

$$E(\eta_{t-i}) = \sqrt{\frac{2}{\pi}},$$

for student-*t* distribution

$$E(|\eta_{t-i}|) = \frac{2\Gamma(\frac{1+\upsilon}{2})\sqrt{(\upsilon-2)}}{1+\sqrt{\pi}(\upsilon-1)\Gamma(\upsilon/2)},$$

for GED

)
)

4. Forecast Evaluation Methods

The comparison of forecasting performance of GARCH models requires the actual volatility denoted by σ_t^2. As such, it provides the natural benchmark for forecast evaluation purposes. A common model-free indicator of volatility is the daily squared return. However, one can obtain a more accurate measure by following an idea proposed by Merton (1980) and Schwert (1989) and formalized by Andersen and Bollerslev (1998). They argued that the single squared change is a noisy indicator for the latent volatility in the period, because the idiosyncratic component of a single change is large. The noise is reduced by taking the sum of all squared intra-period changes, and the smaller the sub-period, the larger the noise reduction. Since the highest frequency available to us is daily data, this idea results in the use of the daily squared return $\sigma_t^2 = r_t^2$ as actual volatility.

We have summed the daily realized volatility over the k-days to obtain the volatility at k-step-ahead (for k >1) i.e. $\sigma_{T+k}^2 = \sum_{j=1}^{k} \sigma_{T+j}^2$. Similarly, k-step-ahead volatility forecast $\hat{\sigma}_{T+k|T}^2$ is the aggregated sum of the forecasts made at time T i.e. $\hat{\sigma}_{T+k|T}^2 = \sum_{j=1}^{k} \hat{\sigma}_{T+j|T}^2$.

The evaluation of forecast ability of competing volatility models is not an easy task, as pointed by Bollerslev, Engle and Nelson (1994), and Lopez (2001), and there does not exist an exceptional measure of selecting the best model. Hansen, Lunde and Nason (2003b) applied the Model Confidence Set (MCS) procedure of Hansen, Lunde and Nason (2003a) to a set of volatility models in order to pick the 'best' forecasting model, amongst case volatility models. As in this approach, the performance of a forecast may be evaluated by using an out-of-sample evaluation under a loss function specified by the user. But like many researchers (e.g., Peter, 2001 and Marcucci, 2005), this paper simply uses different statistical loss functions, available in literature for volatility forecast evaluation. These loss functions will be used as diagnostic tools on the forecasting model.

lity of different models, the paper also uses
at have different interpretations. These are
given as:

1. $$MSE1 = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\sigma_{t+1} - \hat{\sigma}_{t+1|T}\right)^2 .$$

2. $$MSE2 = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\sigma^2_{t+1} - \hat{\sigma}^2_{t+1|T}\right)^2 .$$

3. $$MAE1 = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\left|\sigma^2_{t+1} - \hat{\sigma}^2_{t+1|T}\right|\right).$$

4. $$MAE2 = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\left|\sigma_{t+1} - \hat{\sigma}_{t+1|T}\right|\right).$$

5. $$MAPE = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\left|\frac{\sigma^2_{t+1} - \hat{\sigma}^2_{t+1|T}}{\sigma^2_{t+1}}\right|\right).$$

6. $$TIC = \frac{\sqrt{\frac{1}{h+1}\sum_{t=T}^{T+h}\left(\sigma^2_{t+1} - \hat{\sigma}^2_{t+1|T}\right)^2}}{\sqrt{\frac{1}{h+1}\sum_{t=T}^{T+h}\left(\sigma^2_{t+1}\right)} + \sqrt{\frac{1}{h+1}\sum_{t=T}^{T+h}\left(\hat{\sigma}^2_{t+1|T}\right)}}.$$

7. Mincer-Zarnowitz R^2.

8. $$R^2 LOG = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\log(\sigma^2_{t+1} / \hat{\sigma}^2_{t+1|T})\right)^2 .$$

9. $$HMSE = \frac{1}{h+1}\sum_{t=T}^{T+h}\left(\sigma^2_{t+1} / \hat{\sigma}^2_{t+1|T} - 1\right)^2 .$$

In the above cases h is the forecast horizon.

are the mean square error (MSE). These on the scale of the dependent variable. The criteria (5), (4) and (9) are the mean absolute error (MAE) and mean absolute percentage errors (MAPE), respectively. The MSE's are more sensitive to outliers than MAE's. The measure in (6) is the Theil inequality coefficient (TIC) which is scale invariant. It always lies between zero and one, where zero indicates a perfect fit. The loss function in (7) is computed in Mincer-Zarnowitz regressions (Mincer-Zarnowitz 1969), by regressing the actual variance σ^2_{T+k} on the constant and forecasted variance $\hat{\sigma}^2_{T+k|T}$,

$$\sigma^2_{T+k} = a + b\hat{\sigma}^2_{T+k|T} + v_{T+k}.$$

The statistic R^2 from this regression provides the proportion of variance explained by the forecast i.e. the higher the R^2, better the forecasts. The R^2 LOG, named by Pagan and Schwert (1990) as the logarithmic loss function, penalizes volatility forecasts asymmetrically in low and high volatility periods. The loss function in (9) is the k-adjusted MSE (HMSE), proposed by Bollerslev and Ghysels (1996).

5. Empirical Results and Discussions

5.1. Data and Methodology

In this section, we describe the data and our methodology. The whole sample consists of the KSE 100 index of Pakistan closing prices from January 1, 2002 to August 31, 2006, for a total of 1218 observations. The estimation process is run using four years of data (2002-2005) while the remaining eight months (January 1, 2006 to August 31, 2006) data are used for the evaluation of the out of sample forecast performance. The indices prices are transformed into their rates of returns.

First of all, the statistical properties of returns are assessed through means of coefficients of skewness and kurtosis, Jarque-Bera test of normality, ARCH LM test and Ljung-Box test on the squared residuals to check the presence of typical stylized facts.

Table-5.1: Descriptive Statistics of r_t

Mean	St .Dev	Min.	Max.	Skewness	Kurtosis	Jarque-Bera test	LM(10)	$Q^2(10)$

).1958	6.9837	811.8576	225.1666	536.2900	

Table-5.1, represents the descriptive statistics of r_t. The Jarque-Bera statistic is high due to excess kurtosis and negative skewness, indicating the non-normality of the distribution. Moreover, LM (10) statistics is the ARCH-LM test proposed by Engle (1982), $Q^2(10)$ is the Ljung-Box test statistics on the squared residuals up to lag of 10. Under the null of no serial correlation, the high values for both the statistics indicate the presence of ARCH effect in the conditional variance.

For the identification of the mean model, we have followed the Box-Jenkins methodology. A number of tentative models with increasing ARMA orders and increasing GARCH orders have been estimated. Appropriate models are identified using autocorrelation function (ACF), partial autocorrelation function (PACF) and Ljung-Box statistics of the standardized residuals and the squared standardized residuals and ARCH-LM test. Through this exercise, a GARCH (1, 1) process is found to be the best model for conditional variance. The final model amongst the models, satisfying the diagnostics is selected on the basis of Akiake information criterion (AIC) and Schwarz's Bayesian information criterion (BIC) given in the Appendix. The selected model is given as

$$r_t = \phi_0 + \phi_9 r_{t-9} + \varepsilon_t .$$

Table-1, presents the estimation results for the parameters for the mean model, GARCH, GJR, EGARCH and APARCH models with three distributions: normal, student-t and GED. Asymptotic k-consistent standard errors are given in parentheses. To estimate and forecast volatility, we use the popular software, EViews 5.0

Table-1: Estimates of Symmetric and Asymmetric GARCH Models with Different Conditional Distributio

	GARCH -N	GARCH-St	GARCH -GED	GJR-N	GJR - St	GJR - GED	EGARCH-N	EGARCH - St	EGARCH -GED	APARCH-N	APARCH -St	A
ϕ_0	0.2366*	0.2661*	0.2297*	0.2288*	0.2586*	0.2245*	0.2311*	0.2553*	0.2227*	0.2327*	0.2552*	0
	(0.0350)	(0.0314)	(0.0298)	(0.0363)	(0.0319)	(0.0303)	(0.0398)	(0.0307)	(0.0291)	(0.0308)	(0.0311)	(
ϕ_9	0.0232	0.0399	0.0270	0.0258	0.0412	0.0280	0.0223	0.0393	0.0269	0.0229	0.0397	0
	(0.0284)	(0.0270)	(0.0266)	(0.0319)	(0.0264)	(0.0261)	(0.0280)	(0.0261)	(0.0259)	(0.0315)	(0.0262)	(
γ_0	0.1131*	0.0956*	0.0995*	0.1286*	0.1085*	0.1145*	0.2350*	0.2914*	0.2656*	0.1063*	0.0875*	0
	(0.0314)	(0.0291)	(0.0300)	(0.0228)	(0.0315)	(0.0331)	(0.0483)	(0.0400)	(0.0378)	(0.0216)	(0.0272)	(
γ_1	0.2081*	0.2652*	0.2289*	0.1827*	0.2217*	0.1950*	0.3643*	0.4390*	0.3999*	0.2117*	0.2592*	0
	(0.0455)	(0.0540)	(0.0445)	(0.0305)	(0.0582)	(0.0514)	(0.0648)	(0.0636)	(0.0582)	(0.0231)	(0.0467)	(0.0424)
ω_1	0.7502*	0.7302*	0.7416*	0.7343*	0.7169*	0.7248*	0.9274*	0.9379*	0.9301*	0.7655*	0.7514*	0.7544*
	(0.0423)	(0.0394)	(0.0403)	(0.0273)	(0.0412)	(0.0430)	(0.0177)	(0.0181)	(0.0201)	(0.0281)	(0.0403)	(0.0435)
β_1	-	-	-	0.0652*	0.1001	0.0866	-0.042*	-0.0454	-0.0487	0.1319*	0.1179	0.1364
				(0.0350)	(0.0750)	(0.0659)	(0.0409)	(0.0344)	(0.0323)	(0.0639)	(0.0845)	(0.0935)
δ	-	-	-	-	-	-	-	-	-	1.2087*	1.2529*	1.2244*
										(0.2603)	(0.3587)	(0.3855)
υ		4.5760*	1.2185*		4.5446*	1.2182*		4.6618*	1.2285*		4.6722*	1.2265*
		(0.6996)	(0.0647)		(0.6963)	(0.0656)		(0.7260)	(0.0666)		(0.7181)	(0.0656)
Q(12)	15.08	15.404	14.531	14.98	15.339	14.37	15.381	15.725	14.724	15.155	15.518	14.643
$Q^2(12)$	5.9887	6.1195	6.3398	5.1828	5.4006	5.71	6.1556	6.0281	6.4493	5.7019	5.4891	5.7759

Note: Each GARCH model has been estimated with a normal (N), student-*t* (St) and a GED distribution. Asymptotic heteroscedasticity-consistent standard errors are given in parentheses. "*" indicates the significance of the estimates. *Q(12 and Q^2 (12are* the Ljung-Box statistics at lag 12.

...l mean, $\hat{\phi}_0$ is highly significant for all the models. However, ϕ_9 is non-significant, although we do not drop this parameter because by doing so, the ACF of the standardized residuals becomes significant at lag 9. Moreover, as our main focus is on the forecasts of volatility and by dropping this parameter, the forecast's accuracy reduces. The conditional variance estimates show that all the parameters are highly significant except asymmetric parameters in the cases of student-*t* and GED distributions. In addition, for the student-*t* distribution, the values of shape parameterυ for GARCH, EGARCH, GJR and APARCH clearly indicate the typical fat-tail behavior of financial returns. Moreover, for the GED, the estimates clearly suggest that the conditional distribution has fatter tails than the normal distribution, since the shape parameters for GARCH, EGARCH, GJR and APARCH have values that significantly between 1 and 2 indicating the conditional distribution of KSE 100 index is indeed fat-tailed. Ljung Box statistics at lag 12, $Q(12)$ and $Q^2(12)$ on the standardized residuals and the squared standardized residuals respectively, are non-significant indicating that all these models adequately described the dynamics of the series.

Table-2: In-sample Measures of Goodness-of-fit (Models Comparison)

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log (L)	Rank	AIC	Rank	BIC	Rank	S R
Normal-Distribution																							
GARCH	1.1478	4	34.0721	4	2.4680	4	2.3532	4	0.5585	3	0.8226	4	1.3870	4	4.6662	3	-1722.87	4	3.3389	3	3.3628	2	
GJR	1.1351	3	33.1513	3	2.4500	3	2.3354	3	0.5513	1	0.8197	3	1.3849	3	4.6651	2	-1722.06	3	3.3393	4	3.3679	3	
EGARCH	1.0940	1	31.8213	1	2.3948	1	2.2862	1	0.5697	4	0.8135	1	1.3830	2	4.6216	1	-1717.76	1	3.3309	1	3.3596	1	
APARCH	1.1143	2	32.3411	2	2.4273	2	2.3145	2	0.5530	2	0.8157	2	1.3830	1	4.7328	4	-1718.6	2	3.3345	2	3.3679	4	
Student-t Distribution																							
	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log (L)	Rank	AIC	Rank	BIC	Rank	s
GARCH	1.2147	4	35.0137	4	2.5733	4	2.4499	4	0.5360	3	0.8406	4	1.3972	4	4.8092	1	-1673.23	4	3.2449	3	3.2736	1	36
GJR	1.2056	3	34.0130	3	2.5625	3	2.4379	3	0.5260	2	0.8393	3	1.3959	3	4.8238	2	-1672.37	3	3.2452	4	3.2786	3	32
EGARCH	1.1486	1	32.0584	1	2.4855	1	2.3694	1	0.5378	4	0.8301	1	1.3921	2	4.9137	3	-1670.77	2	3.2421	1	3.2755	2	19
APARCH	1.1816	2	33.1271	2	2.5260	2	2.4040	2	0.5258	1	0.8316	2	1.3901	1	5.0367	4	-1670.21	1	3.2429	2	3.2811	4	23
Generalized Errors Distribution																							
	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log (L)	Rank	AIC	Rank	BIC	Rank	sum	sum Rank
GARCH	1.1609	4	33.7022	4	2.4880	4	2.3724	4	0.5510	3	0.8223	4	1.3766	4	5.0191	2	-1679.29	4	3.2566	3	3.2853	1	37	4
GJR	1.1493	3	32.9369	3	2.4701	3	2.3540	3	0.5411	2	0.8195	3	1.3742	3	5.0382	3	-1678.47	3	3.257	4	3.2904	3	33	3
EGARCH	1.1015	1	31.7533	1	2.4091	1	2.3004	1	0.5576	4	0.8128	1	1.3732	2	5.0126	1	-1676.35	2	3.2529	1	3.2863	2	17	1
APARCH	1.1293	2	32.1318	2	2.4483	2	2.3343	2	0.5409	1	0.8153	2	1.3726	1	5.1609	4	-1676.32	1	3.2547	2	3.2929	4	23	2

Note: MSE1, MSE2, MAE1, MAPE, TIC, MAE2, R2LOG and HMSE are the statistical loss functions given in Section 4. Log (L) is the log-likelihood value, AIC is the Akiake information criteria, BIC is the Schwarz' s information criteria and Sum Rank is the sum of the ranks of the individual loss functions. Final Rank is the Rank of Sum Rank.

del comparison in terms of measures of onstrate that the performance of asymmetric GARCH models with all the three distributions justified the use of asymmetric GARCH models to estimate the series as highlighted by the values of the log-likelihood. According to AIC, EGARCH perform the best in all the three cases. According to the statistical loss functions considered in this study, the EGARCH model with normal and non-normal innovations fits the best, since the sum of the ranks is the smallest. The second best model is the APARCH. However, the performance of GARCH model with all the three distributions is poorest, as the sum of the ranks of all the measures is highest in each case.

Table-3: In-sample Measures of Goodness-of-fit (Distribution Comparison)

GARCH

Distribution	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log(L)	Rank	AIC	Rank	BIC	Rank	Sum Rank	Rank
Normal	1.1478	1	34.0721	2	2.4680	1	2.3532	1	0.5585	3	0.8226	2	1.3870	2	4.6662	1	-1722.87	3	3.3389	3	3.3628	3		
Student-t	1.2147	3	35.0137	3	2.5733	3	2.4499	3	0.5360	1	0.8406	3	1.3972	3	4.8092	2	-1673.23	1	3.2449	1	3.2736	1		
GED	1.1609	2	33.7022	1	2.4880	2	2.3724	2	0.5510	2	0.8223	1	1.3766	1	5.0191	3	-1679.29	2	3.2566	2	3.2853	2		

GJR

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log(L)	Rank	AIC	Rank	BIC	Rank	Sum Rank	Rank
Normal	1.1351	1	33.1513	2	2.4500	1	2.3354	1	0.5513	3	0.8197	2	1.3849	2	4.6651	1	-1722.06	3	3.3393	3	3.3679	3	22	2
Student-t	1.2056	3	34.0130	3	2.5625	3	2.4379	3	0.5260	1	0.8393	3	1.3959	3	4.8238	2	-1672.37	1	3.2452	1	3.2786	1	24	3
GED	1.1493	2	32.9369	1	2.4701	2	2.3540	2	0.5411	2	0.8195	1	1.3742	1	5.0382	3	-1678.47	2	3.257	2	3.2904	2	20	1

EGARCH

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log(L)	Rank	AIC	Rank	BIC	Rank	Sum Rank	Rank
Normal	1.0940	1	31.8213	2	2.3948	1	2.2862	1	0.5697	3	0.8135	2	1.3830	2	4.6216	1	-1717.76	3	3.3309	3	3.3596	3	22	2
Student-t	1.1486	3	32.0584	3	2.4855	3	2.3694	3	0.5378	1	0.8301	3	1.3921	3	4.9137	2	-1670.77	1	3.2421	1	3.2755	1	24	3
GED	1.1015	2	31.7533	1	2.4091	2	2.3004	2	0.5576	2	0.8128	1	1.3732	1	5.0126	3	-1676.35	2	3.2529	2	3.2863	2	20	1

APARCH

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	Log(L)	Rank	AIC	Rank	BIC	Rank	Sum Rank	Rank
Normal	1.1143	1	32.3411	2	2.4273	1	2.3145	1	0.5530	3	0.8157	2	1.3830	2	4.7328	1	-1718.6	3	3.3345	3	3.3679	3	22	2
Student-t	1.1816	3	33.1271	3	2.5260	3	2.4040	3	0.5258	1	0.8316	3	1.3901	3	5.0367	2	-1670.21	1	3.2429	1	3.2811	1	24	3
GED	1.1293	2	32.1318	1	2.4483	2	2.3343	2	0.5409	2	0.8153	1	1.3726	1	5.1609	3	-1676.32	2	3.2547	2	3.2929	2	20	1

...ution comparison in terms of measures that ...esults show that the overall comparison is difficult. According to the log-likelihood, AIC and BIC, the competing models fit the best with fat-tailed distributions and prominent student-*t*, while the symmetric and asymmetric GARCH models with normal distribution perform the poorest. According to other measures, all the competing models with student-*t* innovations perform the poorest. Overall, on the basis of all the measures, all the competing models fit best on the series with GED innovations.

Table-4: In-sample Measures of Goodness-of-fit (Overall Comparison)

Model	*MSE1*	*Rank*	*MSE2*	*Rank*	*MAE1*	*Rank*	*MAPE*	*Rank*	*TIC*	*Rank*	*MAE2*	*Rank*	*R2LOG*	*Rank*	*HMSE*	*Rank*	*Log(L)*	*Rank*	*AIC*	*Rank*	*BIC*	*Rank*	*S*	*R*
GARCH-N	1.1478	6	34.0721	11	2.4680	6	2.3532	6	0.5585	11	0.8226	8	1.3870	8	4.6662	3	-1722.87	12	3.3389	11	3.3628	10		
GARCH- St	1.2147	12	35.0137	12	2.5733	12	2.4499	12	0.5360	3	0.8406	12	1.3972	12	4.8092	5	-1673.23	4	3.2449	3	3.2736	1		
GARCH-GED	1.1609	9	33.7022	9	2.4880	9	2.3724	9	0.5510	7	0.8223	7	1.3766	4	5.0191	9	-1679.29	8	3.2566	7	3.2853	5		
GJR-N	1.1351	5	33.1513	8	2.4500	5	2.3354	5	0.5513	8	0.8197	6	1.3849	7	4.6651	2	-1722.06	11	3.3393	12	3.3679	11	80	8
GJR - St	1.2056	11	34.0130	10	2.5625	11	2.4379	11	0.5260	2	0.8393	11	1.3959	11	4.8238	6	-1672.37	3	3.2452	4	3.2786	3	83	9.5
GJR - GED	1.1493	8	32.9369	6	2.4701	7	2.3540	7	0.5411	6	0.8195	5	1.3742	3	5.0382	11	-1678.47	7	3.2570	8	3.2904	7	75	7
EGARCH-N	1.0940	1	31.8213	2	2.3948	1	2.2862	1	0.5697	12	0.8135	2	1.3830	6	4.6216	1	-1717.76	9	3.3309	9	3.3596	9	53	2
EGARCH-St	1.1486	7	32.0584	3	2.4855	8	2.3694	8	0.5378	4	0.8301	9	1.3921	10	4.9137	7	-1670.77	2	3.2421	1	3.2755	2	61	4
EGARCH-GED	1.1015	2	31.7533	1	2.4091	2	2.3004	2	0.5576	10	0.8128	1	1.3732	2	5.0126	8	-1676.35	6	3.2529	5	3.2863	6	45	1
APARCH-N	1.1143	3	32.3411	5	2.4273	3	2.3145	3	0.5530	9	0.8157	4	1.3830	5	4.7328	4	-1718.6	10	3.3345	10	3.3679	12	68	5
APARCH-St	1.1816	10	33.1271	7	2.5260	10	2.4040	10	0.5258	1	0.8316	10	1.3901	9	5.0367	10	-1670.21	1	3.2429	2	3.2811	4	74	6
APARCH-GED	1.1293	4	32.1318	4	2.4483	4	2.3343	4	0.5409	5	0.8153	3	1.3726	1	5.1609	12	-1676.32	5	3.2547	6	3.2929	8	56	3

l in-sample measures of goodness of fit. The the largest log-likelihood is given by the APARCH model with student-t innovations, while AIC indicates that the best model is EGARCH with student-t innovations. Overall, the sum of the ranks of all statistical loss functions show that the EGARCH models with GED and normal innovations respectively fit the best followed by the EGARCH and APARCH models while the performance of the GARCH model is the poorest.

5.2. Forecast Evaluation

The main goal of our study is to compare the forecasting ability of different GARCH models. Such a comparison has been carried out by comparing the volatility forecasts at one-, five- ten-, fifteen- and twenty-steps-ahead. Forecasting ability of competing GARCH models is reported by ranking according to the statistical loss functions given in section 4 through Table-5 to Table-11. We have compared the results in terms of model comparisons and distribution comparisons at all the one-, five- ten-, fifteen- and twenty-steps-ahead forecast horizons. But the scope of the present paper has been limited to the case of ten-steps, as the rest of the cases follow a similar pattern. However, the total comparison is given for all the forecast horizons. Finally the best performing model is selected by ranking the sum of the ranks of the individual loss functions.

Table-5: One-step-ahead Volatility Forecast (Overall Comparison)

Model	*MSE1*	*Rank*	*MSE2*	*Rank*	*MAE1*	*Rank*	*MAPE*	*Rank*	*TIC*	*Rank*	*MAE2*	*Rank*	*R2LOG*	*Rank*	*HMSE*	*Rank*	$\bar{R}$	*Rank*	*Sum R*	
GARCH-N	1.3911	6	26.2033	9	3.4340	9	3.3396	9	0.4290	11	0.9741	9	1.2592	6	2.8967	11	26.80%	12	82	
GARCH- St	1.4621	11	26.6177	11	3.4721	12	3.3720	12	0.4062	4	0.9832	12	1.2850	11	2.7673	7	27.30%	10	90	
GARCH- GED	1.4095	9	26.2764	10	3.4430	10	3.3486	10	0.4211	9	0.9751	10	1.2629	8	3.0169	12	26.90%	11	89	
GJR-N	1.3613	3	25.1544	2	3.3609	2	3.2656	2	0.4141	7	0.9590	2	1.2505	1	2.7746	8	29.70%	3	30	2
GJR - St	1.4438	10	25.7453	7	3.4050	7	3.3032	7	0.3898	1	0.9694	7	1.2791	10	2.6138	4	30.50%	1	54	5
GJR - GED	1.3810	5	25.1091	1	3.3526	1	3.2570	1	0.4024	3	0.9570	1	1.2547	4	2.8549	10	30.20%	2	28	1
EGARCH-N	1.3424	1	25.6853	5	3.3718	4	3.2764	4	0.4401	12	0.9626	4	1.2509	2	2.5900	2	28.90%	6	40	4
EGARCH- St	1.3985	7	25.4276	4	3.4059	8	3.3051	8	0.4107	6	0.9714	8	1.2753	9	2.4645	1	29.30%	4	55	6
EGARCH- GED	1.3482	2	25.3367	3	3.3624	3	3.2668	3	0.4275	10	0.9600	3	1.2515	3	2.6647	5	29.00%	5	37	3
APARCH-N	1.3788	4	25.6954	6	3.3876	5	3.2917	5	0.4203	8	0.9645	6	1.2584	5	2.6851	6	28.20%	9	54	7
APARCH-St	1.4690	12	26.6698	12	3.4525	11	3.3512	11	0.3987	2	0.9779	11	1.2864	12	2.5943	3	28.30%	8	82	9
APARCH-GED	1.4026	8	25.8091	8	3.3917	6	3.2954	6	0.4090	5	0.9644	5	1.2624	7	2.7888	9	28.50%	7	61	8

Evaluation

Table 9 shows the forecast evaluation at one step ahead. The model comparison recommends that asymmetric GARCH models perform the best for all the three distributions made obvious by final ranks. For all the three distributions, the pattern of the ranks of the final ranks (the ranks of the sum of the individual loss functions) is (4, 1, 2, 3), for GARCH, GJR, EGARCH and APARCH respectively. This indicates that the first best model is the GJR and the second best model is EGARCH. APARCH provide less satisfactory results while symmetric GARCH, clearly, gives the poorest forecasts.

The comparison between densities is harder because results vary across models. The symmetric GARCH and APARCH show the pattern of the ranks of the final ranks as (1, 3, 2), for normal, student-*t* and GED respectively, indicating the best results are obtained with normal innovations. While GJR and EGARCH gives the final ranks as (2, 3, 1) for normal, student-*t* and GED respectively revealing the best results with GED innovations. At one-step-ahead, the forecasting ability of all the competing models with student-*t* innovation is the poorest.

The overall comparison of the forecasting performance of the competing models shows that GJR model with GED innovations seems to perform the best.

Table-6: Five-step-ahead Volatility Forecast (Overall Comparison)

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	$\bar{R}^2$	Rank	Sum R	
GARCH-N	1.32432	12	156.3150	11	8.2034	12	0.7067	11	0.2376	12	0.9095	12	0.0764	12	0.3364	11	67.20%	12	105	
GARCH- St	1.27149	9	143.2830	7	8.0344	10	0.7199	12	0.2316	9	0.8837	8	0.0743	11	0.2586	5	68.90%	10	81	
GARCH- GED	1.28468	10	149.6940	10	8.0797	11	0.6926	9	0.2337	10	0.8918	11	0.0737	9	0.3111	9	67.70%	11	90	
GJR-N	1.15814	3	134.4730	4	7.6944	3	0.6692	4	0.2220	3	0.8560	3	0.0697	5	0.2860	6	71.70%	4	35	3
GJR - St	1.13908	2	124.1580	1	7.5075	2	0.6848	7	0.2188	2	0.8315	2	0.0687	2	0.2237	1	73.70%	1	20	2
GJR - GED	1.10302	1	124.5740	2	7.4853	1	0.6509	1	0.2162	1	0.8301	1	0.0663	1	0.2572	4	72.90%	2	14	1
EGARCH-N	1.29718	11	161.8200	12	8.0021	9	0.6813	5	0.2358	11	0.8899	10	0.0739	10	0.3382	12	70.50%	6	86	10
EGARCH- St	1.16652	4	132.8610	3	7.7133	4	0.6906	8	0.2224	4	0.8563	4	0.0709	6	0.2550	2	71.80%	3	38	4
EGARCH- GED	1.19415	6	145.8940	9	7.7513	5	0.6568	2	0.2259	6	0.8585	5	0.0693	4	0.2991	8	71.70%	4	49	6
APARCH-N	1.24599	7	145.5180	8	7.9715	8	0.6817	6	0.2303	8	0.8854	9	0.0726	8	0.3209	10	69.30%	9	73	8
APARCH-St	1.25041	8	139.6170	6	7.9643	7	0.7037	10	0.2293	7	0.8747	7	0.0722	7	0.2558	3	70.30%	7.5	62.5	7
APARCH-GED	1.19267	5	136.2520	5	7.8351	6	0.6653	3	0.2248	5	0.8647	6	0.0692	3	0.2894	7	70.30%	7.5	47.5	5

... Evaluation

Table 6 shows the forecast comparison at five-steps-ahead. The model comparison gives a pattern similar to the final ranks at one-step-ahead forecast horizon. So, the use of asymmetric GARCH model versus the symmetric GARCH is strongly recommended. For all three distributions the first best model is again the GJR and the second best model is EGARCH. APARCH provides less satisfactory results while symmetric GARCH clearly gives the poorest forecasts.

The comparison between densities led to the use of non-normal densities since all the competing models give better forecasts with fat-tail distributions. The symmetric GARCH and EGARCH show the pattern of the ranks of the final ranks as (3, 1, 2), for normal, student-t and GED respectively, indicating the best results lie with student-t innovations. Moreover, GJR and APARCH give the final ranks as (2, 3, 1) for normal, student-t and GED respectively revealing the best results with GED innovations. At five-steps-ahead the forecasting ability of all the competing models with normal innovation is poorest.

Overall results illustrate that the GJR model with GED is again the most successful model to forecast the volatility of KSE 100 at five steps-ahead.

Table-7: Ten-step-ahead Volatility Forecast (Model Comparison)

Normal-Distribution

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Ra
GARCH	1.1690	3	215.7860	3	10.3088	3	0.4199	4	0.1618	3	0.8555	3	0.0367	4	0.1516	3	86.20%	4	30
GJR	0.9685	1	173.7340	1	9.2787	1	0.3878	1	0.1471	1	0.7787	1	0.0321	1	0.1286	1	88.70%	1	9
EGARCH	1.2628	4	275.1420	4	11.3735	4	0.4189	3	0.1685	4	0.9046	4	0.0361	3	0.1579	4	87.40%	2	32
APARCH	1.0875	2	199.9680	2	9.9860	2	0.4059	2	0.1559	2	0.8289	2	0.0345	2	0.1435	2	86.90%	3	19

Student-t Distribution

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Rank	Rank
GARCH	1.0265	3	168.1730	2	9.3143	3	0.4090	4	0.1510	3	0.7794	3	0.0339	4	0.1143	3	87.80%	4	29	3
GJR	0.9204	1	148.6420	1	8.7418	1	0.3883	1	0.1428	1	0.7364	1	0.0308	1	0.1026	1	90.10%	1	9	1
EGARCH	0.9617	2	169.3140	3	9.2365	2	0.3979	2	0.1464	2	0.7709	2	0.0323	2	0.1132	2	88.50%	2	19	2
APARCH	1.0349	4	172.8760	4	9.5142	4	0.4075	3	0.1514	4	0.7880	4	0.0333	3	0.1144	4	88.10%	3	33	4

Generalized Errors Distribution

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Rank	Rank
GARCH	1.0763	4	190.0480	3	9.5939	3	0.3991	4	0.1550	3	0.8026	3	0.0342	4	0.1362	4	86.80%	4	32	4
GJR	0.8729	1	146.1900	1	8.6625	1	0.3671	1	0.1395	1	0.7304	1	0.0293	1	0.1130	1	89.50%	1	9	1
EGARCH	1.0732	3	223.6930	4	10.2588	4	0.3893	3	0.1551	4	0.8247	4	0.0321	3	0.1341	3	88.80%	2	30	3
APARCH	0.9780	2	168.7410	2	9.2602	2	0.3843	2	0.1476	2	0.7749	2	0.0316	2	0.1258	2	87.80%	3	19	2

Table-8: Ten-step-ahead Volatility Forecast (Distribution Comparison)

GARCH

Distribution	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Ra
Normal	1.1690	3	215.7860	3	10.3088	3	0.4199	3	0.1618	3	0.8555	3	0.0367	3	0.1516	3	86.20%	3	27
Student-t	1.0265	1	168.1730	1	9.3143	1	0.4090	2	0.1510	1	0.7794	1	0.0339	1	0.1143	1	87.80%	1	10
GED	1.0763	2	190.0480	2	9.5939	2	0.3991	1	0.1550	2	0.8026	2	0.0342	2	0.1362	2	86.80%	2	17

GJR

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Ra
Normal	0.9685	3	173.7340	3	9.2787	3	0.3878	2	0.1471	3	0.7787	3	0.0321	3	0.1286	3	88.70%	3	26
Student-t	0.9204	2	148.6420	2	8.7418	2	0.3883	3	0.1428	2	0.7364	2	0.0308	2	0.1026	1	90.10%	1	17
GED	0.8729	1	146.1900	1	8.6625	1	0.3671	1	0.1395	1	0.7304	1	0.0293	1	0.1130	2	89.50%	2	11

EGARCH

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Rank	Rank
Normal	1.2628	3	275.1420	3	11.3735	3	0.4189	3	0.1685	3	0.9046	3	0.0361	3	0.1579	3	87.40%	3	27	3
Student-t	0.9617	1	169.3140	1	9.2365	1	0.3979	2	0.1464	1	0.7709	1	0.0323	2	0.1132	1	88.50%	2	12	1
GED	1.0732	2	223.6930	2	10.2588	2	0.3893	1	0.1551	2	0.8247	2	0.0321	1	0.1341	2	88.80%	1	15	2

APARCH

	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum Rank	Rank
Normal	1.0875	3	199.9680	3	9.9860	3	0.4059	2	0.1559	3	0.8289	3	0.0345	3	0.1435	3	86.90%	3	26	3
Student-t	1.0349	2	172.8760	2	9.5142	2	0.4075	3	0.1514	2	0.7880	2	0.0333	2	0.1144	1	88.10%	1	17	2
GED	0.9780	1	168.7410	1	9.2602	1	0.3843	1	0.1476	1	0.7749	1	0.0316	1	0.1258	2	87.80%	2.0	11	1

Table-9: Ten-step-ahead Volatility Forecast (Overall Comparison)

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	$\bar{R}^2$	Rank	Sum Ra	
GARCH-N	1.1690	11	215.7860	10	10.3088	11	0.4199	12	0.1618	11	0.8555	11	0.0367	12	0.1516	11	86.20%	12	101	
GARCH- St	1.0265	6	168.1730	3	9.3143	6	0.4090	10	0.1510	6	0.7794	6	0.0339	8	0.1143	4	87.80%	7.5	56.5	
GARCH- GED	1.0763	9	190.0480	8	9.5939	8	0.3991	7	0.1550	8	0.8026	8	0.0342	9	0.1362	9	86.80%	11	77	
GJR-N	0.9685	4	173.7340	7	9.2787	5	0.3878	3	0.1471	4	0.7787	5	0.0321	4	0.1286	7	88.70%	4	43	
GJR - St	0.9204	2	148.6420	2	8.7418	2	0.3883	4	0.1428	2	0.7364	2	0.0308	2	0.1026	1	90.10%	1	18	2
GJR - GED	0.8729	1	146.1900	1	8.6625	1	0.3671	1	0.1395	1	0.7304	1	0.0293	1	0.1130	2	89.50%	2	11	1
EGARCH-N	1.2628	12	275.1420	12	11.3735	12	0.4189	11	0.1685	12	0.9046	12	0.0361	11	0.1579	12	87.40%	9	103	12
EGARCH- St	0.9617	3	169.3140	5	9.2365	3	0.3979	6	0.1464	3	0.7709	3	0.0323	6	0.1132	3	88.50%	5	37	3
EGARCH- GED	1.0732	8	223.6930	11	10.2588	10	0.3893	5	0.1551	9	0.8247	9	0.0321	5	0.1341	8	88.80%	3	68	8
APARCH-N	1.0875	10	199.9680	9	9.9860	9	0.4059	8	0.1559	10	0.8289	10	0.0345	10	0.1435	10	86.90%	10	86	10
APARCH-St	1.0349	7	172.8760	6	9.5142	7	0.4075	9	0.1514	7	0.7880	7	0.0333	7	0.1144	5	88.10%	6	61	7
APARCH-GED	0.9780	5	168.7410	4	9.2602	4	0.3843	2	0.1476	5	0.7749	4	0.0316	3	0.1258	6	87.80%	7.5	40.5	4

t Evaluation

The model comparison at the ten-step-ahead forecast horizon is given by Table-7. The model that reveals the best forecasting ability lies again with GJR for all the three distributions as highlighted by all the loss functions given in Table-7. The comparison between the other models is complicated because the results are conflicting. For the normal and GED, the second best model is APARCH while it performs the poorest with student-*t*. On the other hand the performance of EGARCH is better with student-*t* versus normal and GED.

Table-8 shows the distribution comparison. The results favor the use of non-normal densities, since all the symmetric and asymmetric GARCH models provide better forecasting performance with non-normal innovations. However, within non-normal distributions GARCH and EGARCH better perform with student-*t* distribution while GJR and APARCH better perform with GED innovations.

Yet again, overall the preeminent model is GJR with GED innovations as obvious by Table-9. All statistical loss functions except HMSE and R^2 strongly support the use of GJR with GED innovations to forecast the volatility of KSE 100 at the ten-step-ahead forecast horizon. The second best model is also GJR with student-*t* innovations.

Table-10: Fifteen-step-ahead Volatility Forecast (Overall Comparison)

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	R^2	Rank	Sum R	
GARCH-N	1.3057	11	376.8350	10	13.9771	11	0.3333	12	0.1402	11	0.9219	11	0.0248	12	0.1040	11	88.60%	12	101	
GARCH- St	1.1190	6	280.9210	5	12.2034	5	0.3218	8	0.1294	6	0.8181	5	0.0229	8	0.0771	5	90.10%	8.5	56.	
GARCH- GED	1.1796	8	323.5380	8	13.0083	8	0.3170	7	0.1331	8	0.8625	8	0.0230	9	0.0915	9	89.10%	11	76	
GJR-N	1.0498	5	295.3630	7	12.3591	7	0.3042	2	0.1256	5	0.8256	7	0.0210	4	0.0857	7	91.00%	4.5	48.5	5
GJR - St	1.0055	2	247.6760	2	11.4464	2	0.3074	5	0.1225	2	0.7751	2	0.0207	2	0.0693	1	92.20%	1	19	2
GJR - GED	0.9249	1	238.9310	1	11.3914	1	0.2884	1	0.1178	1	0.7679	1	0.0191	1	0.0736	2	91.60%	2	11	1
EGARCH-N	1.4510	12	500.9240	12	15.1625	12	0.3313	11	0.1481	12	0.9671	12	0.0245	11	0.1103	12	90.10%	8.5	102.5	12
EGARCH- St	1.0252	3	280.0880	4	11.8905	3	0.3083	6	0.1240	3	0.7955	3	0.0213	6	0.0754	3	91.00%	4.5	35.5	3
EGARCH- GED	1.1915	10	395.1090	11	13.4655	10	0.3047	4	0.1340	10	0.8679	9	0.0212	5	0.0904	8	91.30%	3	70	8
APARCH-N	1.1814	9	334.6460	9	13.3475	9	0.3232	9	0.1333	9	0.8873	10	0.0230	10	0.0953	10	89.70%	10	85	10
APARCH-St	1.1224	7	282.2960	6	12.2704	6	0.3240	10	0.1294	7	0.8245	6	0.0226	7	0.0761	4	90.70%	6	59	7
APARCH-GED	1.0362	4	271.1030	3	12.1523	4	0.3043	3	0.1247	4	0.8156	4	0.0209	3	0.0814	6	90.50%	7	38	4

Table-11: Twenty-step-ahead Volatility Forecast (Overall Comparison)

Model	MSE1	Rank	MSE2	Rank	MAE1	Rank	MAPE	Rank	TIC	Rank	MAE2	Rank	R2LOG	Rank	HMSE	Rank	$\bar{R}$	Rank	Sum Ra	[illegible]
GARCH-N	1.3492	11	475.1710	10	16.9441	11	0.2916	11	0.1231	11	0.9739	11	0.0197	11	0.0846	11	91.50%	12	99	[illegible]
GARCH- St	1.1340	6	324.8810	4	13.4860	4	0.2771	7	0.1126	6	0.8162	5	0.0186	9	0.0642	4	92.80%	9	54	[illegible]
GARCH- GED	1.1946	8	388.0730	8	15.4516	8	0.2772	8	0.1158	8	0.9005	8	0.0183	7	0.0748	8	91.90%	11	74	[illegible]
GJR-N	1.0701	5	360.5740	7	14.7528	7	0.2651	3	0.1096	5	0.8620	7	0.0167	2	0.0697	7	93.40%	5.5	48.5	[illegible]
GJR - St	1.0495	4	298.5630	2	12.7917	1	0.2688	6	0.1082	4	0.7846	2	0.0171	6	0.0593	1	94.50%	1	27	2
GJR - GED	0.9263	1	273.3120	1	12.8225	2	0.2485	1	0.1019	1	0.7726	1	0.0153	1	0.0606	2	94.00%	2	12	1
EGARCH-N	1.5762	12	692.7570	12	18.8929	12	0.2924	12	0.1333	12	1.0411	12	0.0197	12	0.0920	12	92.90%	8	104	12
EGARCH- St	1.0332	2	330.0540	5	13.6925	5	0.2663	4	0.1076	2	0.8095	3	0.0171	5	0.0622	3	93.70%	4	33	3
EGARCH- GED	1.2566	10	522.0150	11	16.4300	10	0.2674	5	0.1189	10	0.9186	9	0.0171	4	0.0748	9	93.90%	3	71	8
APARCH-N	1.2103	9	410.0270	9	15.8875	9	0.2821	10	0.1166	9	0.9253	10	0.0184	8	0.0783	10	92.50%	10	84	10
APARCH-St	1.1550	7	333.3850	6	13.2211	3	0.2778	9	0.1135	7	0.8099	4	0.0186	10	0.0649	5	93.40%	5.5	56.5	7
APARCH-GED	1.0384	3	310.1140	3	13.7412	6	0.2632	2	0.1079	3	0.8245	6	0.0168	3	0.0674	6	93.10%	7	39	4

ast Evaluation

The model comparison at fifteen-step-ahead volatility forecast also shows that GJR provides the best forecasting ability for all the three distributions.

The forecasting ability of all the symmetric GARCH and asymmetric GARCH models is better with non- normal densities than with normal densities.

The overall performance of GJR is the best in the model comparison and in the densities comparison.

5.3.5. Twenty- step-ahead Forecast Evaluation

At twenty-step-ahead forecasting, the competing models reveal the same forecasting performance with normal and non-normal densities as at the fifteen-step-ahead forecast horizon. So, similar conclusions may be drawn as at fifteen-step-ahead forecast horizon.

It is conspicuous that the R^2 is higher when using non-normal distributions and is highest when using a student-t distribution at all the forecast horizons. Its value also increases from shorter to longer forecast horizons e.g., the highest value at one-day forecast horizon is 30.50% and is 94.50% at twenty-days forecast horizon. But it does not mean the forecast is inadequate at shorter forecast horizons, as explained by Anderson and Bollerslev (1998) and Klaassen (2002). The primary reason for the low R^2 at shorter forecast horizons is the noise in the observed volatility measure. As discussed in Section 4, this noise can be reduced by taking the sum of squared changes over sub-periods. To give an indication of the magnitude of the effect of this noise reduction on R^2, Anderson and Bollerslev compute the R^2 for a GARCH(1,1) model on daily mark/dollar and yen/dollar exchange rates using a single squared daily changes and using the sum of 288 squared five-minute changes in a day. The R^2 increases and they conclude that GARCH does provide good volatility forecasts despite the low R^2 that is typically obtained using the single squared change. For the purpose of this paper, the argument also explains why the R^2 is higher for the longer horizons than for the shorter horizons; in the return series the noise has been reduced in the twenty-day realized volatility by using twenty instead of one squared returns. Further the R^2 is also the highest for the GJR model with student-t innovations, at all the one-day, five-day, ten-day, fifteen-day and twenty-day forecast horizons.

...recommend that volatility forecasts of the ...l by using asymmetric GARCH models with non-normal distributions at both short and long forecast horizons. It is also apparent that the GJR model with GED innovations outperforms the other models, at all the forecast horizons.

6. Conclusion

The essential goal of this paper was to compare the performance of several GARCH-type models (GARCH, EGARCH, GJR and APARCH) in estimating and forecasting the volatility of the KSE 100 index. Such a comparison is carried out by comparing one-day, five- day, ten-day, fifteen-day and twenty-day-ahead volatility forecasts. In addition, all the models are estimated assuming both normal and fat-tailed distributions such as student-t and GED for the innovations. The comparison was focused on different aspects: the difference between symmetric and asymmetric GARCH (i.e. GARCH versus EGARCH, GJR and APARCH), and the difference between normal and fat-tailed distributions.

Our results show that traceable improvements can be made when an asymmetric GARCH model is used in estimating volatility of the KSE 100 return series. Generally, according to the statistical loss functions, among the competing models, EGARCH and APARCH fit the series better than GJR models. Also, the symmetric GARCH model provides the poorest results to fit the series. All the models with GED innovations fit the series the best. Overall, on the basis of rank of the sum of the ranks of individual loss functions, EGARCH with GED fits the best.

Overall, the empirical results show that GJR with all the three distributions seems to provide superior forecasting performance at all one-day, five day ten-day, fifteen-day and twenty-day-ahead volatility forecasts horizons according to the statistical loss functions. So, it may be concluded that the asymmetric effect is central to estimating the quadratic effect for forecasting. The symmetric GARCH model performs poorly according to the statistical loss functions, especially at shorter forecast horizons. Moreover, non-normal distributions, generally, provide better out-of-sample results than the normal distribution.

Further, according to the different statistical loss functions that evaluate out-of-sample forecasts, the GJR model with GED innovations seems to provide superior forecast ability at both shorter and longer forecast horizons. So, it may be concluded that it is the best way to forecast volatility of KSE 100 index is at shorter and longer forecast horizons.

Appendix

Table-A: Model Selection

Models	LogL	AIC	BIC
ARMA(9, 0)-GARCH(1, 1)	-1722.870	3.3388	3.3627
ARMA(2, 2)-GARCH(1, 1)	-1731.888	3.3395	3.3775
ARMA(3, 0)-GARCH(1, 1)	-1749.293	3.3756	3.4041
ARMA(3, 0)-GARCH(2, 2)	-1745.653	3.3724	3.4105

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Book Review

Anwar, Mumtaz, *The Political Economy of Foreign Aid to Pakistan*, Nomos Verlagsgesellscharft, Baden-Baden, 2007, pp. 141, Price not mentioned.

There are an increasing number of studies that analyze the discrepancies between the stated and the actual motives behind giving aid to developing economies. Given this divergence the subsequent effectiveness of aid is also questioned, paving way for debates on whether aid should be given at all. An analysis of the former question of motives is imperative to understand whether aid will have a positive impact on economies with weak institutions, political instability and economic decision-making backed by the need to preserve the status quo.

The book under review has established a well-grounded premise with reference to foreign aid and developing countries such as Pakistan. It has successfully brought together extensive literature that has delineated various methods to analyze the motives behind bilateral and multilateral aid and also evaluate its effectiveness. From a theoretical point of view, it has sought to answer questions involving the impact of aid in general and specifically on savings and investments. Further, it also looks into what factors determine the volume and allocation of aid by investigating incentive mechanisms in developed countries that lead to a greater amount of aid being given.

The book can essentially be divided into three parts, the first dealing with a review on literature to acquaint the reader with the direction of thought and contemporary views on foreign aid and Pakistan in particular. This has been coherently done by first critically examining studies on aid projections to Pakistan followed by a review of whether aid supplements or substitutes savings in the country. As a corollary, the book further examines whether aid has had a positive impact on growth and other macro-economic variables; the definition of foreign aid not being limited to bilateral aid only. The sub-section on multilateral aid enlists that weak growth in Pakistan is not purely indicative of an economic problem but of several socio-political problems and structural weaknesses such as unequal distribution of income, inadequacy of the savings and investment rates,

. Thus, most studies point towards little or growth in Pakistan setting the stage for questioning what actually governs the allocation of funds to the country.

Studies in the past have revealed that geopolitical considerations have been at the centre of aid allocation decisions with regard to Pakistan. The book takes this a step forward and further undertakes a review of literature on foreign aid allocation vis-à-vis developing countries in general. The preliminary section examines aid allocation decisions through models that incorporate donor interest and recipient need simultaneously. The literature indicates that aid is not categorically determined by donor interest or recipient need as the intent varies across donors. However, it may also be interesting to note that irrespective of the two factors, the proclivity of aid is either towards trading partners or old colonies with to political governance in recipient countries. In the discussion on multilateral aid, political and institutional variables in addition to need on the part of developing nations and benevolence of IFIs have been brought under scrutiny through various studies that have been conducted.

However, the significance of the second part is inherent in the discussion of the utility functions of various groups or lobbies in the donor country. In this, the book dwells on an explanation of how aid to developing countries can augment the utility of politicians, voters, bureaucrats and interest groups which include business lobbies, ethnic groups and NGOs. For instance, literature indicates that business lobbies can influence both bilateral and multilateral aid to developing countries based on their infrastructure, debt recovery needs, etc. in the country of operation. By highlighting different stakeholder nodes, these explanations in the second part form the basis of the hypotheses tested in the third.

The third part is the primary contribution of the author where he has examined the nature of foreign aid and its determinants empirically. 'The Evidence' undertakes an investigation into the history of aid flows to Pakistan with reference to changes in Pakistan's strategic geo-political status. It looks into the sources of bilateral and multilateral aid to Pakistan as well. Accordingly, the United Stated ranks the highest in the list of bilateral donors while the World Bank followed by the ADB and the IMF are the largest source of multilateral aid to Pakistan. However, in likeness to the second part, the significance of the third lies in the hypotheses generated based on the utility maximization discussion mentioned above. The econometric analysis subsequently points towards the significance of variables such as FDI from the US to Pakistan and India and non-governmental lobbying expenses undertaken by Pakistanis and Indians in the

Pakistan. On the multilateral front, it is GDP per capita is unequivocally linked to higher aid. Moreover, the analysis points towards the IMF and IBRD rewarding good policy performance and the IDA and ADB responding to greater need highlighted by worsening budget deficits. The utility maximization discussion also lends weight as bureaucratic and U.S and Japanese trade interests play a significant role in determining aid flows to Pakistan.

Mumtaz Anwar has been successful in analyzing the contributing factors to foreign aid in Pakistan. He has exhaustively explored linkages through which flows can be explained at both the bilateral and multilateral levels. This study would provide grounds for further exploration of aid and its impact as it clears and resolves the suspended issues on the sources side. The fact that he has taken in to account recipient need and donor interest in aid allocation to Pakistan is an achievement and a unique contribution to the existing literature on this issue. As the general data availability improves over time the model presented in this book can be used as the main premise for a much more detailed examination of connecting issues pertaining to aid and foreign inflows. The importance of the analysis presented will be much appreciated by students who in addition to understanding aid in the context of Pakistan also want to learn about the existing literature on foreign aid in general given the difficulty of accessing renowned works of literature in Pakistan.

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