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BOOK REVIEW

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Mediating Effect of Advertising Expenditure on Labour Productivity: A Case of Manufacturing Industries in Pakistan

TARIQ MAHMOOD

This paper explores the possibility that the labour productivity enhancing effects often ascribed to capital intensity may partly act through some mediating variable. The paper uses a mediation model to estimate direct and indirect effects of capital intensity on labour productivity in Pakistan's manufacturing industries. The data involve 229 industries at five-digits level of aggregation. The data are taken from Census of Manufacturing Industries for the year 2005-06. Using capital intensity as an independent variable and advertising expenditure as a mediating variable, the paper estimates total, direct, and indirect effects on labour productivity. Approximately 18 percent of total effects on labour productivity are found to be mediated through advertising expenditure. The statistical significance of indirect effects is tested using standard normal tests as well as bootstrap method, and these effects are found to be significant.

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1. INTRODUCTION

In productivity literature capital intensity is often regarded as one of the most important determinants of labour productivity. As pointed out by Arrow, *et al.* (1961), in a linearly homogeneous production function marginal productivity of labour is an increasing function of capital-labour ratio. Usually some other variables like human capital, innovation, trade openness, research and development are included in the model along with capital-labour ratio to analyse determinants of labour productivity [see for example, Velucchi and Viviani (2011); Han, Kauffman, and Nault (2011); Hussain (2009); Apergis, *et al.* (2008)].

All these determinants of labour productivity are important in their own right. However, there is a need to take the analysis one step further, and explore the transmission process through which a determinant may affect labour productivity. An explanatory variable may affect labour productivity directly as well as through some mediating variable. Mediation Model suggested by Baron and Kenny (1986) can be helpful in such a situation. The model gives quantitative estimates of direct and indirect effect of an explanatory variable in a regression equation. A possible missing link in the chain of causation from capital intensity to labour productivity could be advertising expenditure.

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This chain of causation consists of two important relationships. The first one can be established between capital intensity and advertising expenditure. There exist plausible reasons to assume causation from capital intensity to advertising expenditure. First, firms with high capital intensity are usually on higher level of technology adoption. These firms have a forward-looking attitude, and are well aware of modern marketing techniques. Hence they can be expected to spend more on advertising. Second, firms with more capital resources can afford to incur larger advertising expenditures in print and electronic media as well as in other promotional activities. Last, resourceful firms may resort to advertising as a strategy to create barriers for potential entrants, or to drive out existing competitors.[1] These factors induce the firms with high capital to spend more on advertising than those which lack capital resources. The second relationship in this causation chain is established when advertising expenditure, just like other inputs, is included in the value of output.[2] This fact, along with the assumption of positive marginal product, makes advertising expenditure an important contributor to labour productivity.

This paper attempts to disentangle the underlying mechanism of causation from capital intensity to labour productivity through a mediation model. The paper aims to analyse direct and indirect effects of capital intensity. Advertising expenditure is modeled to play the role of mediating variable. The paper contributes to empirical research on manufacturing industries in Pakistan in three important ways. First, it increases our understanding of labour productivity analysis of manufacturing industries in Pakistan. It provides answer to the question: what might be the contribution made by capital intensity in productivity enhancement, and how advertising plays its role in affecting this contribution. Second, from a policy perspective it is important to know that a significant portion of labour productivity enhancement ascribed to capital intensity, in fact, comes from advertising expenditure. This would be helpful for policy-makers to frame regulatory measures about capital markets as well as about advertising activity. Third, this study will pave the way for further research about the role of advertising, e.g. whether advertising is informative and persuasive, as it is often claimed, or is it being used as a strategy by resourceful firms/groups to stifle competition.

The rest of study is divided as follows: Section 2 presents a review of recent empirical literature about the use of mediating variable as well as analysis of labour productivity. Methodology and data are discussed in Section 3. Section 4 discusses empirical results of the model, and Section 5 concludes the discussion.

2. REVIEW OF LITERATURE

Baron and Kenny's (1986) introduced mediation models in the field of psychology. Gradually their use in economics and other social/managerial sciences became common.[3] Some recent empirical studies using mediation models are reviewed below.

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[1] In literature this phenomenon is called "long purse" hypothesis; see for example, Telser (1966).

[2] The issue of including advertising expenditure as an input is explained in Section 3.

[3] For reviews of mediation models in psychology and related fields, see Gelfand, *et al.* (2009), Kenny (2008), and Mathieu, DeShon, and Bergh (2008).

Srivastava and Rai (2013) analyse the mediating role of customer satisfaction in determining the relationship between service quality and customer loyalty. The study uses data from a survey of 400 customers of the top three life insurance companies in India. The companies are selected on the basis of their relative shares in the market of life insurance policies in India. Customer loyalty has been used as dependent variable while independent variable is service quality. Customer satisfaction is used as a mediating variable. Sobel's test is used to examine the significance of mediation model. The study finds that customer satisfaction plays a significant role as a mediator in a service quality-customer loyalty relationship.

Newsham, *et al.* (2009) use a mediated regression model linking the physical environment, through environmental satisfaction, to job satisfaction and other related measures. Physical measurement and questionnaire data are used from 95 workstations in Michigan, USA. The study demonstrates a significant link between overall environmental satisfaction and job satisfaction, mediated by satisfaction with management and with compensation.

Banker, Bardhan, and Chen (2008) study the impact of activity-based costing on plant performance by using world-class manufacturing practices as a mediating variable in a sample of 1250 manufacturing plants in U.S. The study finds that world-class manufacturing practices completely mediate the positive impact of activity-based costing.

Kuha and Goldthrope (2007) develop a mediation model to assess the impact of educational attainment on intergenerational social mobility using British survey data. The study proposes a method to estimate direct and indirect effects between a person's father's and his or her own social classes in systems where some of the variables are categorical. Education is used as a mediating variable to decompose the effect on intergenerational social mobility. The data are used for years 1973 and 1992. Analysis is performed separately for men and women with educational qualification used in seven categories, and social status defined in three classes, viz. (i) Salariat and employers, (ii) Intermediate class, and (iii) Working class. The results indicate high variation in the proportions of indirect effect. This proportion is found to be about 80 percent for women (for mobility from salariat to salariat class) to about 12 percent for men (for mobility from working to working class). However the study does not find any systematic or significant change in proportions of indirect effects between the years 1973 and 1992.

Maydeu-Olivares and Lado (2003) analyse the economic performance of insurance industry in the European Union. The study uses a multiple mediator model to separate the effect of market orientation on economic performance. The mediators used are innovation degree, innovation performance, and customer loyalty. The three mediating variables are found to be interrelated. Customer loyalty alone does not mediate the effect of market orientation on economic performance. However, when it is used in combination with innovation degree and innovation performance, it mediates the effects of market orientation on business performance. It is found that these variables completely mediate effects of market orientation on economic performance. Moreover, there is an improvement in predictions of economic performance by 52 percent over what is explained by market orientation alone.

Productivity has been extensively analysed in empirical literature. A number of writers have studied the issues in the area of total factor productivity (TFP) and explored

its determinants, e.g. Cheema (1978), Mahmood and Siddiqui (2000), and Hamid and Pichler (2009). On the other hand some studies focus on labour productivity, a partial measure, for analysis. A few recent papers dealing with determinants of labour productivity are reviewed below.

Velucchi and Viviani (2011) investigate how some firms' characteristics affect the dynamics of the Italian firms' labour productivity in food, textiles and mechanical machinery sectors. The authors estimate a nonlinear production function by quintiles regression approach using firm-level panel data developed by Italian National Institute of Statistics. The study covers the period of 1998-2004. It is found that the relationships between labour productivity and firms' characteristics are not constant across industries and quintiles. Particularly human capital and innovation have a larger impact on fostering labour productivity of less productive firms than that of highly productive firms. Similarly human capital and innovation have a higher impact for exporters than for non-exporters. Such polarisation is also found within sectors. In food sector innovativeness is significant for low and high productivity firms but it is found to be irrelevant for the median firm. Similarly in textiles the effect of innovation grows as productivity grows. The patents are found to be significant in the machinery sector only for median firms and have very little impact on both low and high productivity firms. Internationalisation turns out to be important for low productivity firms in all sectors.

Han, Kauffman, and Nault (2011) evaluate the contributions of spending in IT outsourcing on labour productivity. The study uses an economy-wide panel dataset in the United States. The data cover sixty industries for the period 1998 to 2006. The authors estimate determinants of labour productivity using IT outsourcing as a mediating input along with other inputs. The results show that on average, a 1 percent increase in spending on IT outsourcing per labour hour is associated with a 0.024 percent to 0.04 percent increase in labour productivity. Separate equations are estimated for the high-and low-IT intensity industry groups. The results show that the coefficient estimates for IT outsourcing are greater in high-IT intensity industries.

Hussain (2009) analyses the causal ordering between inflation, and productivity of labour and capital in Pakistan's economy. The study uses the data from IMF dataset compiled by the United Nations Statistical Database and World Development Indicators covering the period 1960 to 2007. Vector Autoregressive technique is used in the analysis and results suggest that there exists a unidirectional causality from inflation to labour productivity through capital labour ratio. Bidirectional causality between inflation and capital productivity through capital labour ratio is also found. The paper estimates that on average it takes about 15 months for these causalities to take effect.

Kutan and Yigit (2009) estimate determinants of labour productivity growth in eight new EU member states that joined the Union in 2004, namely, the Czech Republic, Estonia, Hungary, Poland, Latvia, Lithuania, Slovakia and Slovenia. The study uses panel data for the period 1995–2006. Results indicate mixed effects of globalisation. FDI and exports increase productivity growth, while imports reduce it. Education, measured by secondary school enrolment, and domestic investment have significant and positive effect while R&D does not play any significant role. Effect of productivity gap is found to be positive and significant, thus implying labour productivity convergence among European countries.

Most of these studies are mainly concerned with finding determinants of labour productivity, or quantifying the impact of these determinants on labour productivity.

There is a need to explore the causal sequence of the impact of one or more determinants on labour productivity. How much is the direct effect of a determinant on labour productivity and how much of the effect is being transmitted through some mediating variable (e.g. advertising)? Present study aims to answer this question.

3. METHODOLOGY

Use of Advertising Expenditure

At macro level advertising has been found to have positive effect on variables like labour supply, consumption etc. [Fraser and Paton (2003); Jung and Seldon (1995)]. However, at firm or industry level the issue is problematic. Advertising is usually not regarded as an input in traditional production analysis. This may partly be due to the perception that advertising, like other marketing strategies, comes into play *after* production process has been completed. Hence its role in productivity enhancement is not relevant. Another reason may have stemmed from the notion of perfect competition. In the words of Pigou (1924, pp. 173-174),"Under simple competition there is no purpose of advertisement, because ex hypothesis, the market will take, at the market price, as much as any one small seller wants to sell." It is probably due to these reasons that a significant body of literature on advertising focuses on its role in market structure, its influences on demand, prices, preferences, quality etc., and its welfare implications, see for example, Hamilton (1972), Hochman and Luski (1988), Horstmann and Moorthy (2003).

Some writers take a divergent perception of advertising. Telser (1978), argues that promotion and the product are joint outputs in supply; thus making advertising an inextricable component of the product. Ehrlich and Fisher (1982), and Richards and Patterson (1998) explicitly treat promotion expenditure as an input in the production process. At empirical level, however, the issue is less problematic. Firms generally include advertisement expenditures in total cost while determining market price of their product. These expenditures are reported in income accounts just like other inputs' costs.

Theoretical Model

This study follows a simple mediation model suggested by Baron and Kenny (1986). This model consists of three variables; independent variable, dependent variable, and mediating variable represented by X, Y, and M respectively. The model represents a causal sequence; X affects M which may in turn affect Y. In addition X may have direct effect on Y which is not transmitted through M. The size and significance of coefficients of these variables decides the nature of mediation.

This model[4] can be described by the following three equations:[5]

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[4]Although a mediation model is not specifically a production model, Equation (1) can be derived from a linearly homogeneous production function with two inputs, in this case, labour and capital. If we divide the production function by labour and take log of both sides, Y becomes log of labour productivity, and X becomes log of capital-labour ratio. In a similar way, Equation (3) can be derived from a linearly homogeneous production function with three inputs, viz. labour, capital, and advertising expenditure. Here M expresses log of advertising expenditure per unit of labour.

[5] These equations do not prove causality in statistical sense. Rather, the coefficients in these equations provide estimates of theoretical causal links among the variable. These theoretical links have been discussed above.

$$Y = i_1 + c\,X + u \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (1)$$

$$M = i_2 + a\,X + v \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (2)$$

$$Y = i_3 + c'\,X + b\,M + e \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (3)$$

Where u, v, and e are random terms satisfying usual OLS assumptions.

Equation (1) establishes direct effect of independent variable on the dependent variable. Equation (2) is used to see how the mediator is affected by the independent variable. Equation (3) shows how mediator affects the dependent variable when direct effect of independent variable is controlled.

As pointed out by Baron and Kenny (1986), the method requires that the coefficients a, b, and c should be statistically significant, and the condition $c' < c$ must hold. Perfect mediation occurs when $c' = 0$. In this case total effect, c, is completely mediated. In general, mediation is not complete, and total effect is said to be partially transmitted through the mediator. Some authors [Collins, Graham, and Flaherty (1998); MacKinnon, Krull, and Lockwood (2000)] argue that significance of c is not necessary for mediation to occur.

The total effect of X on Y, measured by the coefficient c in Equation (1), can be written as combination of direct and indirect effects. If OLS is used to estimate the model, the total effect is the additive sum of the direct and mediated (or indirect) effect [Warner (2012), p. 654]. Symbolically we may state the relationship as:

$$c = c' + ab$$
$$\text{or} \quad ab = c - c'$$

The coefficient 'a' represents the effect of independent variable on mediating variable, and 'b' coefficient represents the effect of mediating variable on dependent variable. The product 'ab' reflects how much a unit change in independent variable affects dependent variable indirectly through mediating variable.

Testing the Significance of Indirect Effects

The tests of significance of indirect effects, 'ab', can be performed in many ways. The most frequently used tests can broadly be grouped in two types; (i) tests based upon the assumption of normality of 'ab', (ii) tests based upon bootstrap technique. These tests will be applied against the null hypothesis of no indirect effects, i.e. H_0: $ab = 0$.

In order to conduct the test under normality assumption, 'ab' is divided by standard error of 'ab' and resulting value is compared with the critical value from the standard normal distribution for a given level of significance. The standard error of the product ab is given by

$$SE_{ab} = \sqrt{(b^2 SE_a^2 + a^2 SE_b^2 + SE_a^2 SE_b^2)} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (4)$$

Where SE_{ab} is standard error of the product 'ab', SE_a is standard error of 'a', and SE_b is standard error of 'b'.

Aroian test uses the above expression to conduct the test of significance. Sobel test assuming independence of 'a' and 'b', omits the last term (i.e. the covariance of 'a' and 'b'). The Goodman test subtracts the last term from the first two terms to form an unbiased estimate of the variance of '*ab*'. These tests are built on the works of Aroian (1947), Sobel (1982), and Goodman (1960) respectively.

The product of two normal variables is, in general, not normally distributed [see e.g. Aroian (1947); Lomnicki (1967)]. It has been argued that the normal theory approach for testing indirect effects lacks statistical power especially for small samples [MacKinnon, *et al*. (2002)]. It is suggested that minimum sample size of 150 to 200 may be regarded as suitable [Warner (2012), p. 663]. Present study applies these tests on 229 observations. So we can expect that these tests will perform better.

Another alternative to the normal theory approach is the bootstrap procedure to test the statistical significance of direct and indirect effects. Bootstrap method, introduced by Efron (1979), allows estimation of the sampling distribution of statistics using resampling methods. Bootstrap method[6] will also be used to estimate and test the significance of direct and indirect effects. The standard deviation of the distribution of bootstrapped 'ab' provides an estimate of the standard error, which could be used in the usual way to construct confidence intervals. Bootstrap technique will be used to compute percentile confidence intervals, and bias-corrected confidence intervals. In the percentile confidence intervals bootstrap estimates are sorted in ascending order and interval limits are chosen corresponding to $(\alpha/2) \times 100^{th}$ and $(1-\alpha/2) \times 100^{th}$ percentile values for a particular α level of significance. In bias-corrected bootstrap confidence intervals the end points of the intervals are adjusted depending upon whether the proportion of bootstrapped values of indirect effects is less than those estimated from the original data.[7]

The null hypothesis of no indirect effects will be tested using these two types of confidence interval. The hypothesis will be rejected if the confidence interval does not contain zero value.

Data and Variables

This study uses data from Census of Manufacturing Industries (CMI), 2005-06.[8] The census is published by Statistics Division, Federal Bureau of Statistics Islamabad. The industries are classified according to Pakistan Standard Industrial Classification (PSIC). CMI provides data at four different levels of aggregation, viz. from two- to five-digits level of aggregation. Data on 230 industries are provided at five-digits level. One of these industrial groups, "lead, zinc, tin and their alloys" is reported to have negative capital assets. This sector is excluded from the analysis. So, the study uses data of 229 industrial groups at five-digits level of aggregation.

The theoretical model given in Equations (1), (2), and (3) is estimated with labour productivity (output per labour) as dependent variable. Capital intensity measured by capital-labour ratio is used as independent variable, and advertising expenditure (per labour) as the mediating variable. The definitions for output, capital, labour, and advertising expenditure as reported in CMI are given below:

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[6]For detail on the procedure see, for example, Shrout and Bolger (2002).
[7]For detail on these three types of confidence intervals, see Hayes (2013), p. 111.
[8]This is the latest CMI dataset presently available.

Output is defined as the contribution of the establishments (in thousand rupees) in each industrial group to the Gross Domestic Product of the economy.

Capital measures value of fixed assets (in thousand rupees) of the industrial group at the end of the year.

Labour consists of average daily persons employed in the industrial group including employees, working proprietors and unpaid family workers.

Advertising expenditures is defined as advertising cost (in thousand rupees) during the year.

Labour Productivity is output in thousand rupees per labour.

All variables are used in regressions in logarithmic form. Ordinary Least Square technique is used to estimate the equations. Summary statistics, graphs, and variance-covariance matrix of the variables in level form are given in Appendix. STATA 12 computer package is used for estimation and testing the regression coefficients. Add-on command "sgmediation" is used to perform tests of significance of indirect effects.[9]

In addition to advertising expenditure other variables like levels of education of workers and managerial staff, work environment, and expenditures on research and development can also play mediating role. Presently CMI data do not include these variables. A more detailed mediating model can be used when such data become available.

4. RESULTS

The estimated results of mediation model outlined in previous section are as follows. The capital intensity or capital-labour ratio is found to play significant role in determination of labour productivity. In terms of our mediation model 'c' is significant (Table 1).

Table 1

Results for Productivity Regressed on Capital Intensity

Number of Obs = 229				
F Statistic = 107.41				
Adj R-Squared = 0.32				
Labour Productivity	Coef.	Std. Err.	t	P > |t|
Capital Intensity	0.57	0.05	10.36	0.00
Const.	2.91	0.35	8.32	0.00

Similarly, causal link from capital-labour ratio to advertising is also statistically significant, or in terms of the mediation model 'a' is significant (Table 2). The result substantiates the hypothesis that capital intensity is a significant predictor of advertising expenditure.

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[9]This computer programme is available at the website of IDRE, Institute for Digital Research and Education, UCLA: http://www.ats.ucla.edu/stat/stata/faq/sgmediation.htm

Table 2

Results for Advertising Expenditure Regressed on Capital Intensity

Number of Obs. = 229
F Statistic = 22.32
Adj R-Squared = 0.08

	Coef.	Std. Err.	t	P > |t|
Capital Intensity	0.58	0.12	4.72	0.00
Const.	−2.39	0.78	−3.08	0.00

The next step of mediation model requires that when dependent variable is regressed on independent variable as well as mediating variable, both explanatory variables should turn out to be significant. Moreover, the size of coefficient of independent variable (capital intensity in our case) should decrease. Table 3 confirms that this condition is also fulfilled. When labour productivity variable is regressed on capital intensity as well as advertisement, both explanatory variables turn out to be statistically significant, and the size of the coefficient of capital intensity decreases from approximately 0.57 (Table 3) to approximately 0.46 (Table 5). From this we can conclude that advertisement does indeed play a mediation role in productivity determination.

As described in the previous section, size of mediation or indirect effect is also given by the product 'ab', which is the product of the coefficient of independent variable in Equation (II) and the coefficient of mediation variable in Equation (III). The estimate of this product turns out to be approximately 0.10. This amount approximately equals the reduction in the estimate of the coefficient of capital intensity due to inclusion of advertisement in the model (Tables 1 and 3).

Table 3

Results for Productivity Regressed on Capital Intensity and Advertisement

Number of Obs. = 229
F Statistic = 85.27
Adj R-Squared = 0.42

Labour Productivity	Coef.	t	P > |t|
Capital Intensity	0.46	8.80	0.00
Advertising Expenditure	0.18	6.57	0.00
Const.	3.34	10.19	0.00

Tests of significance of indirect effects are performed under the assumption of normality of 'ab' as well as using the bootstrap technique. The three tests based upon the assumption of normality of the product 'ab' are Sobel Test, Aroian Test, and Goodman Test. These tests give very similar results (Table 4). The results indicate that the null hypothesis of no indirect effect can be rejected at less than 0.001 level of significance. Table 4 also reports proportion of total effect that is mediated, and ratio of indirect to direct effect. After rounding, approximately 18 percent of total effect of capital intensity on labour productivity is mediated through advertisement. The ratio of indirect to direct effect is approximately 0.22 percent. These numbers indicate relative strength of the effect of mediating variable.

Table 4

Tests of Significance for Indirect Effects (Tests Based upon Assumption of Normality)

	Coeff	z	P > |z|
Sobel	0.10	3.83	0.00
Aroian	0.10	3.80	0.00
Goodman	0.10	3.86	0.00
Proportion of Total Effect that is Mediated =0.18			
Ratio of Indirect to Direct Effect =0.22			

Significance of direct and indirect effects is also tested by using bootstrapped estimates. Bootstrap technique is applied with 5000 replications. The percentile confidence intervals sort the bootstrap estimates in ascending order and choose the interval limits corresponding to $(\alpha/2)x100^{th}$ and $(1-\alpha/2)x100^{th}$ percentile values for a particular α level of significance. On the other hand bias-corrected bootstrap confidence intervals adjust the end points of the intervals depending upon whether the proportion of bootstrapped values of indirect effects is less than those estimated from the original data. Estimates of these two types of interval are reported in Table 5. None of confidence intervals contain zero, which implies significance of direct and indirect effects. Hence the null hypothesis of zero mediation effects is rejected. These results confirm the results from Aroin test, Sobel test and Goodman test. So we can conclude that advertising expenditure does play a significant role as a mediation variable.

Table 5

Test of Significance for Indirect Effect (Test Based upon Bootstrap Method)

No. of Obs	229				
Replications	5000				
	Observed Coeff.	Bootstrap Std. Err.	[95% Confidence Interval]		
Indirect Effect	0.10	0.02	0.06	0.16	(P)*
			0.06	0.16	(BC)**
Direct Effect	0.46	0.06	0.35	0.59	(P)*
			0.35	0.58	(BC)**

*Percentile confidence interval.
**Bias-corrected confidence interval.

SUMMARY AND CONCLUSIONS

This paper uses a simple mediation model to determine direct and indirect effects of capital intensity on labour productivity in manufacturing industries of Pakistan. A simple mediation model is estimated using per labour advertising costs as mediating variable, and capital intensity as independent variable. The results show that indirect effect of capital intensity on labour productivity constitutes approximately 18 percent of total effect. The statistical significance of the indirect effect is tested through standard normal tests as well as through bootstrap methods, and results are found to be statistically significant.

The mediating role of advertising costs indicates some subtle aspects of the relationship between capital and labour productivity. Traditional analysis suggests that capital intensive industries are technologically more advanced, hence their modern equipment and innovative ways of production make labour more productive. This argument may be partly true, but as our analysis suggests a significant portion of this causal chain is, in fact, transmitted through advertising. Policy-makers and regulatory bodies should keep these facts in view while making policies or taking regulatory measures about advertising activity and capital markets.

The study highlights the need for further research to clarify the role of advertising; whether advertising is being used as promotion tool or as a strategy to create entry barriers. When advertising is for promotion and information, it acts like an input, and promotion and the product are joint outputs in supply. So it can be regarded as a contributor to value added. Hence advertising may be productive if it is informative and/or persuasive, but it could be counterproductive if it happens to adversely affect competitive structure of the market.

The study also highlights the need for further improvements in CMI data. Presently CMI data do not include variables like levels of education of workers and managerial staff, and expenditures on research and development. These and other such type of variables may also play a similar mediating role. CMI data set should be extended to include these variables. If more variables could be included in a multi-mediation model, it will further refine direct and indirect effects, and provide better analyses of labour productivity.

APPENDIX

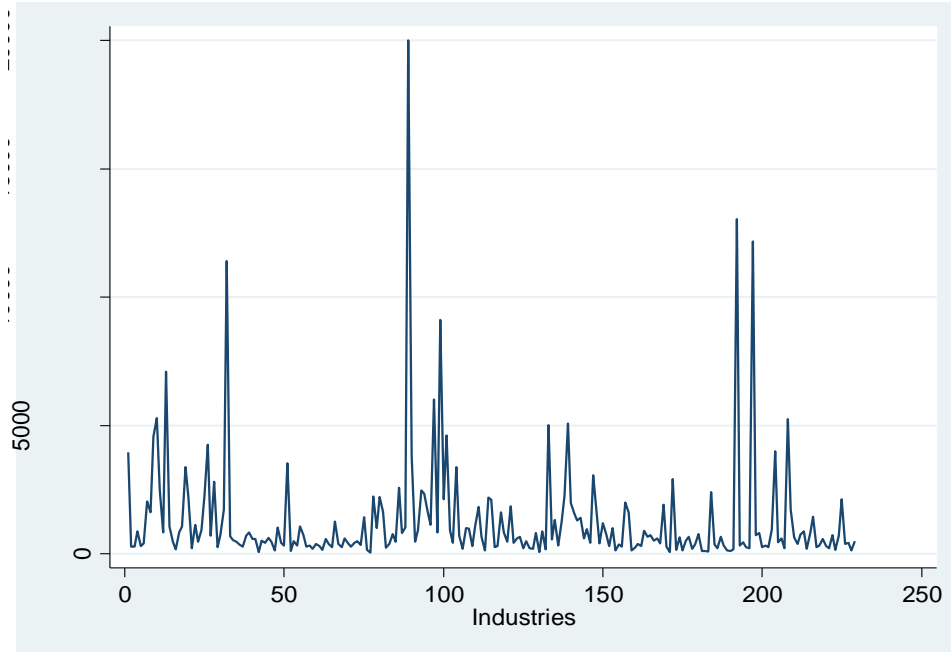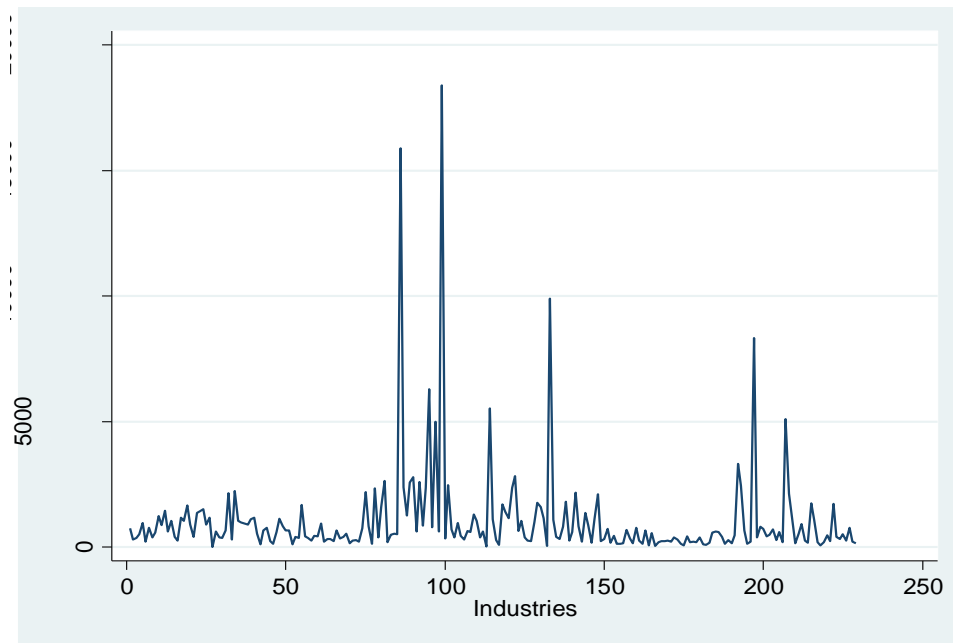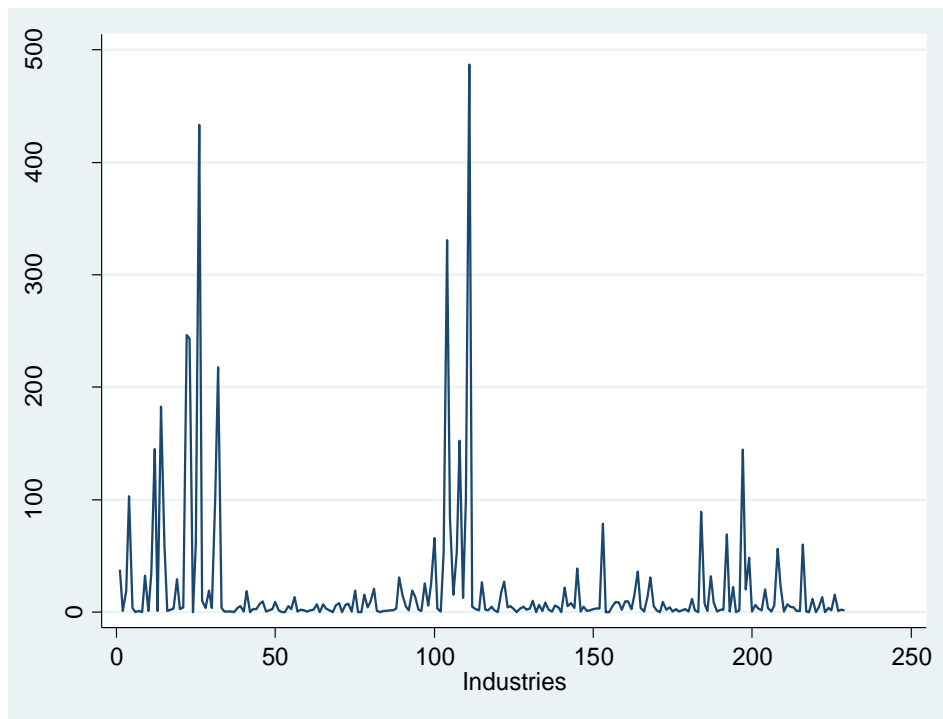### Fig. 1. Labour Productivity (Thousand Rupees)

Fig. 2. Capital Intensity

Fig. 3. Advertising Expenditure (Thousand Rupees)

Appendix Table 1

Summary Statistics of the Variables

Variables	Obs	Mean*	Std. Dev.
Labour Productivity	229	1279.40	2198.22
Capital Intensity	229	1026.88	1930.94
Advertising Expenditure (per Labour)	229	64426.24	208519.20

* Labour productivity and advertising expenditures per labour are in thousand rupees.

Appendix Table 2

Correlation Matrix

	Labour Productivity	Capital Intensity	Advertising Expenditure
Labour Productivity	1		
Capital Intensity	0.44	1	
Advertising Expenditure	0.26	0.06	1

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From Chronic Disease to Food Poverty:
Evidence from Pakistan

ABID A. BURKI, MUSHTAQ A. KHAN, and SOBIA MALIK

While poverty and its causes have long been studied by economists, the link between chronic disease and food poverty has been a neglected area of research. This article investigates the impact of chronic disease on food poverty by using two rounds of panel data of Pakistan and linear probability regression framework. Chronic disease is defined to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. The regression results show that on average the effect of chronic disease on food poverty is statistically equal to zero, but this effect significantly varies by income groups categorised by three non-income based classifications. We note that the incidence of chronic disease is significantly higher among non-poor when permanent income of the household is incorporated into the model, most notably among individuals coming from low- and middle-income backgrounds. Thus public health policies that seek awareness, prevention and treatment of chronic diseases have the potential to alleviate poverty in a high poverty environment.

1. INTRODUCTION

That chronic disease and poverty are interconnected in a vicious cycle has long been recognised in medical science literature [Brundtland (1999)], however, the causal pathway of disease and poverty has not been so simple and clear cut. Human capital literature suggests a positive relation between health and productivity where healthy workers can work, produce and earn more [Becker (2007); Adams, *et al.* (2003); Wagstaff (2007)]. On the contrary, a vast medical science literature concludes that the major direction of influence is from poverty to chronic disease [Phipps (2008)]; however, there are few exceptions [e.g., Schofield, *et al.* (2012)].

Becker (1964) points to the similarity between investment in health and investment in education both as forms of human capital while this idea was further developed by Grossman (1972) and Currie and Madrian (1999), among others. The point they make is that, just like education, health is valued by employers and employees alike because health and the ability and capacity to adequately perform a job are tied together. Apparently, ill health adversely affects the performance of workers and leads to lower levels of productivity, which in turn decreases their earnings potential and enthusiasm to remain in the labour force. By this logic, chronic disease drastically increases the chances of these households falling into abject poverty.

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Severe illness or death of primary income earner is found to be a key factor explaining poverty in low and middle income countries. A World Bank study concludes on the basis of 125 case studies that chronic disease and death are the most common causes of households' impoverishment [Narayan, *et al.* (2000)]. Chronic diseases may impose huge economic burden on vulnerable groups by ruining their economic prospects and pushing them into poverty because people with chronic diseases spend a high proportion of their incomes on health care.[1] People who suffer from chronic diseases often face a terrible choice: either to avoid medical treatment (e.g., for heart attack and stroke) and face early death, or seek health care by making out-of-pocket payments and plunge their family into poverty.

Unfortunately, this approach (poor health causes poverty) has long been discredited in the medical science literature where it is widely believed that the direction of causation is from poverty to chronic disease [Benzeval and Judge (2001); Phipps (2008)]. Similarly, poverty is also considered as the key determinant of child health [see, among others, Nikiema, *et al.* (2010)]; child poverty is also believed to render an adverse impact on adult health [e.g., Lynch and Davey (2005)]. The possibility of reverse causation, i.e., from poverty to chronic disease, makes this relationship complicated.

Emerging data from various sources suggests that the burden of chronic disease is increasing worldwide [Bartley, *et al.* (1999); Chaturvedi, *et al.* (1998); Stronks, *et al.* (1998); White (2000)].While the impact of health status on labour market participation and macroeconomic losses has been explored in many recent studies [e.g., Cai and Kalb (2006); WHO (2005); Bound, *et al.* (1999); Kahn (1998); Stern (1989)],[2] still the association between chronic disease and food poverty is unclear.

This paper investigates the connection between chronic disease and food poverty. We use individual level panel data of Pakistan where the nature of illness and its impact on poverty corresponds well with other developing countries [Narayan, *et al.* (2000)]. Like some other studies [e.g., Bastida and Pagan (2002); Brown, *et al.* (2005); Zhang, *et al.* (2009)], we define chronic disease as occurrence of cardiovascular disease, asthma, arthritis, AIDS, cancer and diabetes to at least one member of the household. The paper employs two rounds of individual-level household panel data from the Micro Impact of Macro Adjustment Policies (MIMAP) conducted by the Pakistan Institute of Development Economics (PIDE), Islamabad. We adopt an empirical framework for the panel data, which controls for systematic shocks to food poverty that are not due to chronic disease.[3]

Due to the suspicion raised by medical science literature that direction of causation is from poverty to chronic disease, we follow the advice of Davidson and MacKinnon (1993) and use Durbin-Wu-Hausman test to verify if instrumental variables (IVs) are necessary. However, we find convincing evidence to conclude that least square estimates

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[1]Chronic diseases may lead to reduced worker productivity, unemployment, premature retirement, disability and death.

[2]The role of specific diseases in impairing labour productivity and efficiency has mostly been studied in the perspective of developed countries. For studies on diabetes, [see Brown, *et al.* (2005); Bastida and Pagan (2002) for asthma, see Smyth, *et al.* (1999); for cardiovascular disease, see Zhang, *et al.* (2009); for arthritis, see Gorin, *et al.* (1999), Lerner, *et al.* (2004); and for mental illnesses, see Adler, *et al.* (2006), Butterworth, *et al.* (2006) and Zhang, *et al.* (2009)].

[3] For empirical evidence on consumer preferences for food items in Pakistan, see Burki (1997).

are consistent on our data. Our results also suggest that chronic disease is higher among non-poor and that chronic disease in the household renders most harmful effects on low- and middle-income individuals by increasing their food poverty.

The paper has the following layout. Before turning to the detailed analysis, we explain the methodology in Section 2. Section 3 describes data source, definition of variables and summary statistics. Section 4 discusses the empirical results and examines the underlying reasons for incidence of food poverty. Section 5 presents conclusions and policy implications.

2. METHODOLOGY

To investigate the impact of chronic disease on food poverty we use the regression of poverty incidence on relevant explanatory variables. By defining x_{it} as a vector of observable variables representing individual and household factors affecting food poverty, the empirical relationship can be expressed as

$$y_{it} = \beta x_{it} + \varepsilon_{it} \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad (1)$$

where y_{it} is an index for individual i, in survey year t and where y_{it} equals 1 if the individual is below the official food poverty line; β are parameters to be estimated and ε_{it} is the usual error term. Since poverty is measured at the individual level, we also take individual rather than household poverty levels.

Estimation of this model with panel data points to some unobserved differences that are likely to be present in the cross-sectional units that need to be accounted for. A general approach to control for unobserved differences in panel setting is to introduce a common intercept across cross sectional units. This can be accommodated by amending the functional relationship in Equation (1) as follows:

$$y_{it} = \alpha + \beta x_{it} + w_{it} \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad (2)$$

where the composite error term w_{it} is defined as $w_{it} = e_i + \varepsilon_{it}$ where e_i is the random error characterising the ith unit and is constant over time and ε_{it} is the usual error term. In this setting, the estimation of the model would depend upon whether e_i is best modeled by a random or a fixed effects estimator.[4] In the random effects model, it is assumed that the observations are randomly sampled from a much larger universe of such individuals or households, which implies that statistical inferences can be generalised for the entire population. Since our sample is drawn from a much larger population, the random effects model is more appropriate for our purposes.

Our dependent variable, y_{it}, is a latent variable that equals 1 if the individual is below food poverty line and equals zero otherwise. In this paper, our preferred regression framework is the linear probability model[5] (LPM), which not only provides remarkably

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[4]The random effects estimator provides unbiased and efficient estimates when $E(e_i \mid x)$ is zero. If true, it indicates that the unobserved effects are uncorrelated with each explanatory variable and the random effects model is more appropriate. However, if the true effects are fixed then a standard least squares dummy variables model or the fixed effects model is more appropriate because the random effects estimator would produce biased parameter estimates.

[5]A probit or a logit are alternative models, but our results are not sensitive to the choice of assumption about the distribution of the error term.

similar estimates to the probit or the logit specification, it is also convenient to interpret because estimated coefficients directly indicate marginal probabilities.

Because the variance covariance matrix of the disturbance term, w_{it}, in the random effects model is not known, we use the feasible generalised least squares (FGLS) estimator, which is the most appropriate method. The estimated linear probability regressions are written as

$$y_{it} = \alpha + \gamma CD_{it} + \beta x_{it} + \tau_t + \delta_j + \eta_k + w_{it} \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad (3)$$

where in addition to the variables defined above, we have *CD* as the variable of interest, which measures chronic disease if at least one member is suffering from chronic disease in household *i* in time period *t*. Because *CD* varies at the household level-year dimension, the estimated standard errors account for clustering at the household/survey year level, in addition to accounting for general form of heteroskedasticity. τ_t controls for differences across time periods in the probability that a household suffers from *CD* and equals 1 if the survey year is 2000-01 and zero if the survey year is 1998-99. Districts vary in many characteristics that are time-invariant (such as pollution levels (determined by proximity to cities, industrial clusters, forest cover, rainfall, etc.) and integration to the economy, which might independently affect the incidence of chronic disease and food poverty and hence might bias our estimated coefficient on *CD*. To the extent that these district characteristics are time-invariant, we include δ_j in Equation (3) to capture them by district-fixed effects. Finally, η_k is for province effects that capture variation in general economic conditions that independently affect food poverty across provinces.

Due to strong belief on reverse causation in the medical science literature, we suspect but are not sure whether endogeneity arises from poverty to chronic disease. In such cases, Instrumental Variables (IV) may or may not be the appropriate model to cure the endogeneity problem. For example, Davidson and MacKinnon (1993) note that even if chronic disease and poverty are endogenous variables, their correlation with error term should be great enough to suggest that using the least squares method may lead to serious bias. And because least squares offer more efficient estimates than IV, we apply Durbin-Wu-Hausman test to decide whether IV estimates are necessary for our data set.[6]

We also test whether chronic disease renders different effects on poverty due to income levels. We do not include household income, which may be endogenous to food poverty. In its place, we use three categories of household socioeconomic variables as proxies for permanent income of the individuals. These proxy variables are mean household education; number of rooms in the house; and presence of sanitation facility in the house. We incorporate permanent income into the model by interacting socioeconomic categories, denoted by λ_{it}, with chronic disease to find differences in respective slopes. The modified regression models take the following form

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[6]To illustrate, the Wu-Durbin-Hausman test measures a systematic difference between the least square and instrumental variable estimates. The null hypothesis $H_0 : \text{plim} (1/n \, X^T \, \varepsilon) = 0$ is a test of exogeneity of explanatory variables. If the null hypothesis holds, it suggests that the least squares are preferred estimates since the asymptotic covariance of least square estimator is never larger than that of the IV estimator. Thus there is no further need to report IV estimates.

$$y_{it} = \alpha + \gamma(CD_{it} \times \lambda_{it}) + \beta x_{it} + \tau_t + \delta_j + \eta_k + w_{it} \qquad \text{...} \qquad \text{...} \qquad \text{...} \qquad (4)$$

Where λ_{it} represents a vector of dummy variables that capture socioeconomic characteristics of individuals. In this specification, the effect of chronic disease on poverty in low-, medium-, and high-income individuals is measured by the γ-coefficients.

3. THE DATA

We use two rounds of panel data from the Pakistan Socio-economic Survey (PSES) collected by the Pakistan Institute of Development Economics (PIDE), Islamabad under the project on Micro Impact of Macroeconomic Adjustment Policies (MIMAP). Round I of the survey was carried out in 1998-99 and Round II was conducted in 2000-01. The sample was drawn from rural and urban areas of the four provinces of Pakistan. The survey adopted a two-stage stratified random sampling design where the enumeration blocks in urban and rural domains were taken as primary sampling units (PSUs). Within a PSU, a sample of 8 households was drawn for data collection from urban domain and 12 households from rural domain. Survey in Round I consisted of 3564 households (2268 households from rural and 1296 households from urban domains). About 80 percent of the sampled households in Round I (or 2850 households) were re-interviewed in Round II of the survey. In Round II, more than 1000 new households were also included for data collection under the sampling frame suggested by the Federal Bureau of Statistics, Government of Pakistan. Total sample of Round II was 4021 households (2577 from rural and 1444 from urban domains).

Our working sample consists of 55,222 individuals from some 7558 households (3546 from Round I and 4012 from Round II), after deleting 27 households (18 from Round I and 9 from Round II) with missing values on food expenditure. Two separate questionnaires, one each for males and females, were administered to each household for data collection. Health section was included only in the female questionnaire to elicit detailed information on illness status and related behaviour of each member of the household including children and adults. This is because females usually attend to the sick members of the household and hence are in a much better position to provide this information.

We define "food poverty" by "the food energy intake method" rather than "the cost of basic needs method".[7] We do not take basic needs poverty because expenditure on basic needs also include expenditure on health that is endogenous to poverty. We calculate food poverty by taking the official food poverty line for 2350 calories per adult equivalent of Rs 361.66 per month in 1998-99 prices and Rs 393.66 in 2000-01 prices [Pakistan (2006)]. In poverty calculations, we account for price differentials across rural and urban areas. In our sample, food poverty was 28 percent in 1998-99, which increased to 40 percent in 2000-01. These estimates favourably compare with the estimates of food poverty obtained by Qureshi and Arif (2001) from the same data set.

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[7]Food energy intake method refers to amount of energy obtained from food, expressed in calories. The basic needs method defines absolute minimum resources needed for physical wellbeing, e.g., food, shelter, clothing, education and healthcare, etc.

Like other studies in the literature [e.g., Bastida and Pagan (2002); Brown, *et al.* (2005); Zhang, *et al.* (2009)], we define "chronic disease" to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. Education is a key determinant of food poverty because households with more education are likely to be more productive and have greater income earning opportunities.[8] We construct "mean household education" variable as average years of schooling of all household members ranging from no education to 16 years of education. To reflect the quality of life of a household, we use "rooms in the house" variable. We assume that households occupying fewer rooms are more likely to be poor. Poor households are less likely to have access to sanitation facilities. Our indicator of sanitation facility is the presence of latrine with flush facility connected to underground sewerage line or to a septic tank. Therefore, we construct the variable namely, "household lacks sanitation facility", as a dummy variable.

Access to gas, telephone and electricity is considered a major determinant of economic status. To examine this effect, we construct three dummy variables on availability of electricity, gas, and telephone connection in the house namely, "household has electricity connection", household has telephone connection" and household has gas connection". Household size may also matter in determining poverty. Therefore, we construct "household size" variable to examine this impact; we expect larger households to be poorer than smaller households. Availability of drinking water inside the house makes life comfortable and is a feature of better quality of life. We construct 12 dummy variables to control for the effect of source of drinking water on poverty. Other household and individual control variables are "head worked at least 1 hour last month" and age of the individual, which is a continuous variable. Year of the survey is a dummy to control for the time period.

Five asset variables included are "real value of animal assets", "real value of durable assets", "land operated", "real value of real estate" and "real value of farm machinery". District dummy variables for rural and urban districts are included to control for time-invariant district specific characteristics that may affect poverty. All nominal variables are normalised by consumer price index (CPI) using 2000-01 as base year. Definition of variables is found in Table 1 while Table 2 reveals descriptive statistics.

4. ESTIMATION RESULTS

In Table 3 we present estimation results for the LPM regression in Equation (3) by using panel data.[9] Because our interest is to separate the effect of chronic disease on food poverty from factors that might independently affect the incidence of food poverty, the regression equations include household/individual attributes, regional and inter-temporal variables to control for time-invariant and time-variant factors on food poverty. We do not include household income as an explanatory variable because this variable is endogenous to food poverty. However, we proxy for household income by including a number of variables directly related to the socioeconomic position of the household, viz., mean household education, number of rooms in the house and availability of sanitation facility in the house.

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[8]For rates of return to education in the formal sector of Pakistan, see Guisinger, *et al.* (1984); for returns in the informal sector, see Burki and Abbas (1991).

[9]The fitted values from the LMP regression suggest that only 4 percent of the values were outside the 0-1 range. Hence the estimated coefficients of the LMP model were almost same as the predicted probabilities obtained from a probit regression.

Table 1

Definition of Variables

Names of Variables	Definition
Dependent Variable	
Poverty	=1 if the individual falls below the food poverty line
Household/Individual Attributes Affecting Food Poverty	
Mean household education (years)	Mean years of education of the household
No mean household education	=1 if the individual belongs to a household with no mean household education
Below 5 years of mean household education	=1 if the individual belongs to a household with 1 to 4 years of mean education
5 to 6 years of mean household education	=1 if the individual belongs to a household with 5 to 6 years of mean education
More than 6 years of mean household education	=1 if the individual belongs to a household with more than 6 years of mean education
Rooms in the house	Number of rooms in the house
1-2 rooms household	=1 if the individual belongs to a household with 1 to 2 rooms
3-5 rooms household	=1 if the individual belongs to a household with 3 to 5 rooms
More than 5 rooms household	=1 if the individual belongs to a household with more than 5 rooms
Household lacks sanitation facility	=1 if the individual belongs to a household where no sanitation facility exists
Real value of animal assets	Real value of animal assets owned by a household in million rupees
Real value of durable assets	Real value of durable assets owned by a household in million rupees
Log of land operated	Natural logarithm of land operated by a household in acres
Real value of real estate	Real value of assets of the household in million rupees
Real value of farm machinery	Real value of farm machinery owned by a household in million of rupees
Tap water inside house	=1 if the individual belongs to a household which has tap water inside the house as a source of drinking water
Open well inside house	=1 if the individual belongs to a household which has open well inside house as a source of drinking water
Hand pump inside house	=1 if the individual belongs to a household which has hand pump inside house as a source of drinking water
Motor pump inside house	=1 if the individual belongs to a household which has motor pump inside house as a source of drinking water
Other sources of drinking water inside house	=1 if the individual belongs to a household which has sources other than mentioned above as a source of drinking water
Open well outside house	=1 if the individual belongs to a household which has open well outside house as a drinking water source

Table 1—(*Continued*)

Hand pump outside house	=1 if the individual belongs to a household which has hand pump outside house as a drinking water source
Canal outside house	=1 if the individual belongs to a household which has canal outside house as a drinking water source
Other sources of drinking water outside house	=1 if the individual belongs to a household which has sources other than mentioned above of water outside house as a drinking water source
Household has electricity connection	=1 if the individual belongs to a household with electricity connection
Household has telephone connection	=1 if the individual belongs to a household with telephone connection
Household has gas connection	=1 if the individual belongs to a household with gas connection
Head worked at least 1 hour last month	=1 if household worked for at least 1 hour for pay or profit during the last month
Household size	Number of family members in a household
Individual is a male	=1 if the individual is a male
Chronic Disease Variables of Interest	
Chronic disease	=1 if at least one individual in the household is suffering from chronic disease
Low income by mean education × chronic disease	=1 if mean household education is 0 years and HH is suffering from chronic disease
Lower middle-income by mean education × chronic disease	=1 if mean household education is 1-4 years and HH is suffering from chronic disease
Upper middle-income by mean education × chronic disease	=1 if mean household education is 5-6 years and HH is suffering from chronic disease
High income by mean education × chronic disease	=1 if mean household education is more than 6 years and HH is suffering from chronic disease
Low income by rooms × chronic disease	=1 if the individual belongs to a household with 1 to 2 rooms and HH suffers from chronic disease
Middle income by rooms × chronic disease	=1 if the individual belongs to a household with 3 to 5 rooms and HH suffers from chronic disease
High income by rooms × chronic disease	=1 if the individual belongs to a household with more than 5 rooms and HH suffers from chronic disease
Low income by sanitation facility × chronic disease	=1 if the individual belongs to a household with no sanitation facility and household is suffering from chronic disease
Period Fixed-effects	
Survey year is 1998-99	=1 if the survey year is 1998-99
Survey year is 2000-01	=1 if the survey year is 2000-01
District and Province Fixed-effects	
130 district dummy variables	=1 if the individual belongs to one of the 130 urban, rural and metropolitan urban areas
Punjab	=1 if individual belongs to Punjab province
Sindh	=1 if individual belongs to Sindh province
KP	=1 if individual belongs to Khyber Pakhtunkhwa province
Balochistan	=1 if individual belongs to Balochistan province

Table 2

Descriptive Statistics

Names of Variables	Mean	SD	Min	Max
Household/Individual Attributes Affecting Poverty				
Mean household education	2.440	2.44	0	16.00
No mean household education	0.329	0.47	0	1.00
Below 5 years of mean household education	0.466	0.50	0	1.00
5 to 6 years of mean household education	0.116	0.32	0	1.00
More than 6 years of mean household education	0.089	0.28	0	1.00
Rooms in the house	2.700	1.56	0	15.00
1-2 rooms household	0.549	0.50	0	1.00
3-5 rooms household	0.446	0.50	0	1.00
More than 5 rooms household	0.004	0.07	0	1.00
Household lacks sanitation facility	0.414	0.49	0	1.00
Real value of animal assets	0.011	0.05	0	5.14
Real value of durable assets	0.099	0.22	0	7.04
Land operated	0.062	2.96	0	256
Real value of real estate	0.240	0.97	0	50.80
Real value of farm machinery	0.012	0.07	0	2.17
Tap water inside house	0.251	0.43	0	1.00
Open well inside house	0.041	0.20	0	1.00
Hand pump inside house	0.365	0.48	0	1.00
Motor pump inside house	0.137	0.34	0	1.00
Other sources of drinking water inside house	0.205	0.40	0	1.00
Open well outside house	0.032	0.17	0	1.00
Hand pump outside house	0.039	0.19	0	1.00
Canal outside house	0.029	0.17	0	1.00
Other sources of drinking water outside house	0.890	0.36	0	1.00
Household has electricity connection	0.795	0.40	0	1.00
Household has telephone connection	0.127	0.33	0	1.00
Household has gas connection	0.224	0.42	0	1.00
Head worked at least 1 hour last month	0.274	0.45	0	1.00
Household size	9.038	4.28	1	35.00
Individual is a male	0.513	0.49	0	1.00
Chronic Disease Variables				
Chronic disease (yes=1, no=0)	0.122	0.33	0	1.00
Low income by mean education × chronic disease	0.031	0.17	0	1.00
Lower middle-income by mean education × chronic disease	0.061	0.24	0	1.00
Upper middle-income by mean education × chronic disease	0.014	0.12	0	1.00
High income by mean education × chronic disease	0.015	0.12	0	1.00
Low income by rooms × chronic disease	0.063	0.24	0	1.00
Middle-income by rooms × chronic disease	0.057	0.23	0	1.00
High income by rooms × chronic disease	0.001	0.03	0	1.00
Low income by sanitation facility × chronic disease	0.041	0.20	0	1.00
Period Fixed-effects				
Survey year is 1998-99	0.0.521	0.46	0	1.00
Survey year is 2000-01	0.573	0.49	0	1.00
District and Province Fixed-effects				
130 district dummy variables	–	–	–	–
Punjab	0.532	0.50	0	1.00
Sindh	0.227	0.42	0	1.00
KP	0.149	0.36	0	1.00
Balochistan	0.092	0.29	0	1.00
Number of Observations	55222	–	–	–

To test whether all the explanatory variables included in regressions are exogenous of households' poverty status, we apply Durbin-Wu-Hausman test on the basic model in column (1) and find that all $\hat{\beta}$ estimates are consistent, which indicates absence of endogeneity of the explanatory variables and thus IV estimates are not necessary on our data.[10] The consistency of the estimated coefficients confirms that there is no reverse causation going from poverty to chronic disease.

The asset variables are not endogenous, which effectively rule out the possibility of "landlessness" and "lack of assets" variables being the consequences rather than the causes of poverty. To this effect, the estimation results presented in Table 3, column (1) and (2), are obtained by including and excluding land operated variable while estimation results in column (3) are obtained by deleting from the regression 9 sources of drinking water dummy variables. The results reveal that the parameter estimates presented in columns (1) – (3) are highly robust to alternative empirical specifications.

In general, the parameter estimates in Table 3 reveal that increase in mean household education significantly decreases food poverty; this result corroborates the findings of some other studies in the literature [e.g., Jalan and Ravallion (1998, 2000) for rural China, Mehta and Shah (2001) for India, and World Bank (2002) and Burki (2011) for Pakistan]. Likewise, number of rooms in house is also negatively correlated with food poverty; the probability of food poverty significantly decreases by 5.1 percent for one additional room in the house. Lack of access to sanitation facilities is another socioeconomic indicator. We find that individuals lacking access to sanitation facilities are more likely to be poor than otherwise. Increased household size places additional burden on household assets due to which food poverty increases in larger households.[11] Ownership of animal assets, land assets, real estate, farm machinery and other durable assets is negatively and significantly correlated with poverty.[12] However, the negative effect on food poverty of animal assets and durable assets dominates as compared with other asset categories. Telephone, electricity and gas connections are all significant, but individuals with telephone connection are relatively much less likely to be poor. To the extent that land-line telephone connection is a luxury in poor households while electricity and gas are necessities, this is an expected result. Likewise, employment of household head is negatively correlated with poverty as expected. Males are somewhat more likely to be poor and poverty is 16.4 percent higher in Round 2 as compared with Round 1.

Our key variable of interest is chronic disease, which indicates that on average chronic disease is more common in non-poor households but this effect is statistically insignificant. This is not a surprising result because it shows average effect of chronic disease on individuals of all incomes. To separate this effect by income groups, we use modified specifications in Table 4 where we interact chronic disease by classifying individuals into socioeconomic groups to test whether this effect varies by income groups.

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[10]Our empirical results do suggest that there is no systematic difference between the least squares and IV estimates and hence we have not reported the IV estimates and have only reported the least square estimates. See also footnote 5.

[11]Others who report similar results are McCulloch and Baulch (2000) for Pakistan, Jalan and Ravallion (1998, 2000) for rural China, and Aliber (2001) for South Africa.

[12]See, for example, Adam and He (1995), McCulloch and Baulch (2000), Gaiha and Deolaiker (1993), Jalan and Ravallion (2000), Mehta and Shah (2001).

Table 3

GLS Regressions on Food Poverty with the Random Effects

Variable Name	(1)	(2)	(3)
Chronic disease (yes=1, no=0)	0.001	0.001	0.0001
	(0.18)	(0.19)	(0.03)
Mean household education (years)	–0.016***	–0.016***	–0.018***
	(–15.96)	(–15.97)	(–17.21)
Rooms in house (numbers)	–0.051***	–0.051***	–0.054***
	(–33.53)	(–33.55)	(–35.24)
Household lacks sanitation facility (yes=1, no=0)	0.061***	0.061***	0.066***
	(12.54)	(12.52)	(13.76)
Real value of animal assets (Rs million)	–0.400***	–0.400***	–0.411***
	(–10.36)	(–10.38)	(–10.36)
Real value of durable assets (Rs million)	–0.146***	–0.146***	–0.148***
	(–14.49)	(–14.50)	(–14.70)
Log of land operated	–0.001**	–	–0.001**
	(–1.93)		(–2.07)
Real value of real estate (Rs million)	–0.003	–0.003	–0.003*
	(–1.26)	(–1.26)	(–1.61)
Real value of farm machinery (Rs million)	–0.221***	–0.222***	–0.234***
	(–8.83)	(–8.84)	(–9.31)
Household has electricity connection (yes=1, no=0)	–0.042***	–0.043***	–0.044***
	(–7.55)	(–7.59)	(–7.94)
Household has telephone connection (yes=1, no=0)	–0.089***	–0.089***	–0.094***
	(–13.00)	(–12.99)	(–13.66)
Household has gas connection (yes=1, no=0)	–0.040***	–0.040***	–0.049***
	(–5.37)	(–5.36)	(–6.52)
Head worked for at least 1 hour last month (yes=1, no=0)	–0.016***	–0.016***	–0.015***
	(–3.96)	(–3.95)	(–3.74)
Household size (numbers)	0.031***	0.031***	0.031***
	(59.73)	(59.74)	(58.98)
Individual is a male (yes=1, no=0)	0.151***	0.151***	0.157***
	(11.99)	(11.97)	(12.41)
Survey year is 2000–01 (yes=1, no=0)	0.164***	0.165***	0.146***
	(38.04)	(38.08)	(35.08)
9 source of drinking water dummy	Yes	Yes	No
District fixed-effects included	Yes	Yes	Yes
Province fixed-effects included	Yes	Yes	Yes
No. of Observations	55222	55222	55222
R^2	0.2075	0.2075	0.2012

Notes: All regression models are estimated using LPM model, which include intercept terms, but they are not reported. Dependent variable is food poverty. Numbers in parenthesis are *t*-statistics based on robust standard errors corrected for household-year clustering. *** and ** denote statistical significance at the 1 percent and 5 percent level, respectively.

In Table 4, we segment individuals into low-, middle- and high-income by using three non-income classification schemes namely, (1) mean household education, (2) number of rooms in the house, and (3) absence/presence of sanitation facility in the house. These non-income classifications serve as proxy for permanent income where, as illustrated below, the differences in slopes are captured by interaction terms with chronic disease.

Table 4

GLS Regressions on Food Poverty by Income Groups with the Random Effects

Variable Name	With mean HH Education as Proxy for Income (1)	With Number of Rooms in the House as Proxy for Income (2)	With Sanitation Facility in the House as Proxy for Income (3)
Chronic disease in HH (yes=1, no=0)	–0.043***	–0.328***	–0.024***
	(–2.76)	(–5.95)	(–3.44)
Low income by mean education × chronic disease	0.081***	–	–
	(4.32)		
Lower middle-income by mean education × chronic disease	0.042***	–	–
	(2.45)		
Upper middle-income by mean education × chronic disease	–0.017	–	–
	(–0.78)		
Low income by rooms × chronic disease	–	0.373***	–
		(6.72)	
Middle income by rooms × chronic disease	–	0.279***	–
		(5.02)	
Low income by sanitation facility × chronic disease	–	–	0.066***
			(5.82)
Mean household education (years)	–	–0.023***	–0.019***
		(–22.12)	(–18.54)
Rooms in house (numbers)	–0.057***	–	–0.054***
	(–38.01)		(–35.60)
Household lacks sanitation facility (yes=1, no=0)	0.074***	0.072***	–
	(15.49)	(14.75)	
Survey year is 2000-01 (yes=1, no=0)	0.129***	0.166***	0.142***
	(31.98)	(39.98)	(34.29)
9 sources of drinking water dummy included	Yes	Yes	Yes
5 household asset variables included	Yes	Yes	Yes
3 electricity, telephone and gas connection variables included	Yes	Yes	Yes
3 dummy variables for head employment, household size and gender of the individual included	Yes	Yes	Yes
Province dummy variables included	Yes	Yes	Yes
District fixed-effects included	Yes	Yes	Yes
No of Observations	55222	55222	55222
R^2	0.1974	0.1848	0.1989

Notes: All regression models are estimated using LPM model, which include intercept terms, but they are not reported. Dependent variable is food poverty. Numbers in parenthesis are *t*-statistics based on robust standard errors corrected for household-year clustering. *** and ** denote statistical significance at the 1 percent and 5 percent level, respectively.

First, we use household education as a proxy for permanent income and estimate Equation (4) to test whether the impact of chronic disease on food poverty varies by income groups. Lower income individuals are defined as those where mean household education is zero; lower-middle income individuals are those where mean household education is up to 4 years; upper-middle income refers to those where mean household education is 5 to 6 years; and high-income refers to individuals where mean household education is more than 6 years. We use these categories to interact them with chronic disease variable to incorporate permanent income into the model, which allows us to capture differences in their slopes.

Column 1 of Table 4 presents the results of the modified specification, which reveals that the incidence of chronic disease is significantly higher for the non-poor. Relative to high income individuals, chronic disease increases the probability of food poverty to 8 percent for individuals coming from low-income households and 4 percent for lower-middle income individuals. As expected, the probability of poverty of upper-middle income individuals is not affected by the chronic disease. These results suggest that chronic disease renders most harmful effects on the poor who suffer from lost labour time and increased health expenditures leading to decline in food expenditure and rise in food poverty. These results can be verified by considering other proxies for income groups.

Secondly, number of rooms in the house is used as a good proxy for permanent income. We assume that most low-income households live in one or two-room houses while middle- and high-income households live in houses with more than two rooms. Therefore, low-income individuals are defined as those who have up to two rooms in the house; middle-income refers to individual who has three to five rooms in the house; and high-income individuals refer to those who have more than five rooms in the house. As before, we incorporate permanent income of the household into the model by interaction terms of these dummy variables with chronic disease. Regression results are presented in column 2 of Table 4. We see that the incidence of chronic disease is disproportionately higher among the non-poor. We also observe strong positive coefficients of the interaction terms of low-income and middle-income individuals with chronic disease. Compared with high-income individuals, chronic disease increases the probability of poverty of low-income and middle-income individuals by 37 percent and 28 percent, respectively. Thus government policies that seek prevention and cure of chronic diseases through increased investments have a stronger power to reduce poverty.

Finally, lack of sanitation facility is taken as a proxy for households' permanent income. Here our assumption is that lack of sanitation facility is negatively correlated with household's income. Therefore, we use presence or absence of sanitation facility to distinguish low-income from high-income individuals and interact it with chronic disease variable. The estimation results are displayed in column 3 of Table 4. The estimated coefficient of the interaction term reveals that chronic disease in the household increases the probability of poverty of low-income individuals by 6.6 percent. This result further confirms the view that individuals from low income households are especially vulnerable to these health shocks. The effect of chronic disease on food poverty of low and middle income individuals may be explained by the possibility of income earning opportunities for households to fall and treatment costs to rise with occurrence of chronic disease.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The association between chronic disease and food poverty has long been a neglected area of research. This paper investigates the impact of chronic disease on food poverty by using two rounds of the individual level panel data of Pakistan. The nature of data used in this study indicates superiority of the random effects estimation procedure over other alternatives. Chronic disease is defined to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. Despite ambiguity in medical science literature on reverse causation going from poverty to chronic disease, Dubrin-Wu-Hausman test confirms that all explanatory variables included in the regression are exogenous. Our estimation results confirm findings that already exist in the empirical literature on the determinants of poverty in Pakistan [World Bank (2002)]. For example, food poverty is negatively correlated with household education; number of rooms in the house; access to sanitation facilities; employment of household head; ownership of land, animal, real estate and durable assets; and negatively to household size.

Classifying individuals into socioeconomic groups on the basis of non-income classification schemes, e.g., mean household education, number of rooms in the house, and absence of sanitation facility in the house, we find that chronic disease is statistically higher among non-poor, but it renders most harmful effects on low-income and middle-income individuals by significantly increasing their probability of food poverty. These results suggest that public health policies designed to promote prevention and awareness as well as treatment/cure of these diseases have the potential to alleviate poverty in an otherwise high poverty environment in the country. Therefore, an increase in government expenditure on health needs to be considered especially by the provincial governments since the health sector has largely been devolved to the provinces after the passage of the 18th Constitutional Amendment. Finally, the results suggest that non-poor individuals in Pakistan are more likely to suffer from chronic disease, an effect that warrants improved awareness to affluent groups in the country.

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The Effects of Informational Framing on Charitable Pledges: Experimental Evidence from a Fund Raising Campaign

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We designed a field experiment to test the direction of the impact of informational frame on charitable pledges. We solicited charitable pledges from 395 students during a campaign aimed at helping students through students at the School of Economics, Quaid-i-Azam University (QAU), Islamabad. The participants are randomly divided into 5 different treatments. In the Pledge Disclosed (PD) treatment, we provided information to students about the average size of pledge we received from participants in the Baseline (BL) treatment. Similarly, in the Need Disclosed (ND) treatment, we provided information about the total need of those who asked for assistantship. In the Pledge & Need Disclosed (P&ND) treatment, we informed the students about both the need as well as the pledge made by the students to meet that need. In All Disclosed (AD) treatment, we provided details about the need, pledges, the previous history of the project, and the pledge by Charity Australia International. The findings show that relative to BL treatment, charitable pledges decreased when participants were informed about the previous pledges and the total required need. However, charitable pledge increased when full information was provided to the participants.

1. INTRODUCTION

Lack of the financial resources to fund higher education is one of the critical issues of developing countries like Pakistan. Most of the students are financed by their parents for their higher education. However, in recent years, there has been an increasing trend in the contributions from philanthropic organisations. In Pakistan, organisations such as karwan-e-ilm, Alfalah scholarship scheme, and Agha Khan Foundation are working in the field of education to assist students.[1] The main source of the income of these organisations is religious donations such as Zakat and other charitable donations from the public. In order to raise funds, they adopt various methods such as advertisement, fund

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[1] http://www.kif.com.pk/, http://www.alfalahss.org/, http://www.akdn.org/akf_scholarships.asp

raising dinners etc. Likewise, they adopt different strategies to assist students such as direct scholarships, purchasing books, or providing uniform etc.

Researchers have analysed the effects of various factors on fund raising. For instance, List and Lucking-Reiley (2002) analysed the impact of seed money and refund on fund raising. The impact of government grants on private donations in the form of crowding in and crowding out has also attracted the attention of scholars (Andreoni and Payne 2011). In crowding out, individual donors consider their voluntary private contributions as a substitute for their involuntary contributions through taxation. Hence, they reduce full amount to a charity. In contrast, in crowding-in individual donors regard their contributions complementary to the contributions of government. Mostly, the concepts of crowding-in and crowding-out have been analysed by the researchers for the cases where both the government and public are contributors to philanthropy. To our knowledge, there is no commendable work on the impact of informational framing on private philanthropic pledges. We fill this gap with an experimental study where we test whether the type of information provided to participants affect the size of pledges or not. These experiments have been carried out in a fund raising campaign for helping students through students in School of Economics QAU, Islamabad.

Like the international literature, philanthropy in Pakistan has been the focus of attention of the researchers [Agha Khan Development Network (AKDN) (2000); Ghaus-Pasha, *et al.* (2002)]. However, none of them addresses the hypotheses raised in this paper. For instance, Agha Khan Development Network (2000) provides a report on the indigenous sources of philanthropy. Ghaus-Pasha, *et al.* (2002) documents the key dimensions such as size, structure, revenue, and the composition of the non-profit sector in Pakistan. Similarly, Abbasi (2011) analyses the success of the non-profit sector of Pakistan in terms of funds generated indigenously. In particular, the study focuses on sectors where the activities of non-profit sector have contributed in terms of infrastructure development and the ripple effect. Additionally, the article explores the philanthropic depth of the society by examining the ability to handle natural or manmade catastrophes over the decades. Unlike the previous studies, here we want to see the impact of information disclosure on philanthropic pledges.

Our study is based on a fund raising campaign which comprises two rounds. In the first round, we went to class rooms in the School of Economics, Quaid-i-Azam University, Islamabad. We read out all the written instructions loudly and invited applications from the needy students for assisting them in the spring semester of 2014. At the end of this round, we received 11 applications from students who were seeking assistantship. In the second round we divided all the students, approached in the first round, into five treatments. Our aim was to take pledges in the form of donations from students for helping those needy students who submitted applications in the first round. Again in the second round, we read out all the written instructions to students in all of the 5 treatments.

In the baseline (BL) treatment, the students were asked to give written pledges on a given form. They could choose an option from the list or could choose any other amount. In the Pledge Disclosed (PD) treatment, the students were provided information about the amount of pledge per student in the BL treatment and they were asked to give pledges on the same written form. The same exercise was repeated in the third treatment

i.e. Need-Disclosed (ND) treatment, where the students were provided with the information about the total need asked by the deserving students in the first round. In the fourth treatment which is called Pledge and Need-Disclosed (P&ND) treatment, the students were asked to make pledges after being informed about the need as well as the amount of pledge per student in all of the previous treatments. In the final treatment, All-Disclosed (AD) treatment, the students were provided all the information about the previous developments. For instance, they were briefed about the history of the campaign, pledges by the students in the previous treatments, the total need, and the financial support from an Australian based charitable organisation.[2]

The findings show both the effects of crowding-out and crowding-in. For instance, crowding-out is observed in the PD treatment while crowding-in is observed in the P&ND and AD treatments. In the ND treatment, the information regarding the need for donations decreases the average rate of pledge relative to the BL treatment. The rest of the paper is organised in five sections. Section 2 reviews some of literature on the hypotheses of crowding-in and crowding-out. Experimental procedure and the description of treatments are provided in Section 3. Section 4 describes the theoretical framework and discusses the main hypotheses of the study. Results are presented in Section 5 while the study is concluded in Section 6.

2. REVIEW OF LITERATURE

To our knowledge, there is no commendable work in the available literature that could explain the effects of information regarding previous pledges on private pledges to charitable organisations. However, there is considerable literature that examines the displacement of donations to the private charitable organisations due to the grant from government. For example, Steinberg (1991), after reviewing 13 studies on the issue of crowding out, finds that a dollar of government spending crowds out private donations by $0.005 to $0.35. In the same way, Payne (1998) finds that the effect is $0.50 for shelter, human services and similar organisations. Onwards, Ribar and Wilhelm (2002) find that the government funding to the international relief organisations crowds out private donations by 23 precent. In contrast, Straub (2003) finds no crowding out for public radio matching grants.

In order to find the causes of crowding-out Andreoni and Payne (2011) proclaim that governemnt grants reduce fund raising activities, and therby reduce the amount raised from private donations. Alternatively, the reduction of fund raising activities dominates the reduction in the rate of donations in the crowding-out effect caused by the government grants.[3] Besides crowding-out, there is also empirical evidence that supports the possibility of crowding-in. For instance, Khanna, *et al.* (1995) finds crowding-in of 9.4 percent in a study of the non-profit organisations in the United Kingdom (UK). Likewise, Khanna and Sandler (2000) find some evidence of crowding-in for government grants in the health and social welfare sectors. In contrast, Payne (2001) reports the evidence that the federal research grants in the United States cause both crowding-in and

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[2]Charity Australia International was the organisation which had offered the financial support before the experiments.

[3]Using a panel of more than 8,000 charities, the study finds significant crowding out but primarily due to reduced fund-raising.

crowding-out of private donations to universities. For instance, the study shows that the federal research funding increases private donations by 65 percent to 100 percent for research universities while similar research funding to liberal arts colleges and non-research universities decreases private donations by 45 percent and 9 percent respectively.

The above literature suggests that people's response to government grant depends on their motive for giving, their information about the nature of the organisations, and their knowledge about the sources of funding. Regarding these issues, Andreoni (1993) provides an important source of information to distinguish between the alternative hypotheses regarding the pattern of contributions. In the study, the crowding-out hypothesis is tested within the framework of a public good game. The game consists of three players and has an interior Nash equilibrium, which is below the level of contributions characterised as Pareto efficient. In one treatment (no-tax), there is no minimum level of contribution. The other treatment (tax) sets a minimum level of investment in the public good. This minimum level is set lower than the equilibrium level of contribution. The treatment is not framed as a tax, but rather the payoff matrix is set up so that there is a two-token minimum. The complete crowding out hypothesis predicts that the total contributions to the public good in both the no-tax and tax treatments (including the two-token tax) would be the same. However, the results show a high level of crowding-out in the tax treatment. For instance, contributions in the no tax treatment are 71.5 percent higher than the contribution in the tax treatment across all the rounds.

In a similar study, Eckel, *et al.* (2005) examines through a controlled experiment whether the third-party contributions crowd-out private giving to a charity. A single dictator game is played by the participants where they choose their preferred rate of charity from a given list. The experiment has four treatments: two initial allocations and two frames. Initial allocations are either $18 for the subject and $2 for the charity or $15 for the subject and $5 for the charity. The participants could then allocate additional funds if they wished so. In the first frame, subjects are simply informed of the initial allocations among themselves and their chosen charity. In the second frame, subjects are told that their allocation of $20 has been taxed, and the tax collected has been given to the charity of their choice. The structure of payoffs is the same in both of the frames. The results show that no participant contributes additional amount in the tax-frame, showing nearly 100 percent crowding-out. In contrast, in the first frame, almost all of the participants contribute some additional amount, showing a close to zero crowding-out.

In most of the above studies, we can observe that the crowding-out is mostly associated with the grants from the government. However, this is quite possible that the information about individuals' grants to charity displace the donations of the private donors. This question is partly analysed by Nikiforakis (2010) in a different context in the creation of a public good game. Nikiforakis (2010) provides feedback to participants in a public good game regarding the earnings and contribution of their peers. The paper shows that the level of cooperation is significantly low in the treatment where subjects receive information about the earnings of their peers as compared to the treatment where subjects receive information about the contributions of their peers. This is in-spite of the fact the feedback format does not affect incentives. Besides Nikiforakis (2010), there is no study that systemically answers this question in the context of charitable pledges. We fill this

gap by showing the effects of information revelation on philanthropic pledges in a field experiment. Moreover, in the informational frame of the earlier researchers, the donation is not passed on to the needy among the same subject pool. While, we study the impact of informational frame on charitable pledges where participants clearly know that their donations will be actually passed on to the needy among the same subject pool.

3. EXPERIMENTAL PROCEDURE AND TREATMENTS

The experiment for our analysis was conducted in the School of Economics, Quaid-i-Azam University (QAU), Islamabad during the months of November and December 2013. In the school, more than 600 students are registered in four programs, i.e. BS, MSc, MPhil, and PhD. The experiment comprised two rounds. In the first round, applications were sought from the needy students for financial assistantship. During the teaching hours, after getting approval from the concerned teachers, we visited class rooms and provided the details of the project by reading out the written instructions.[4] The students were asked to submit their applications for financial assistantship within a week at the main office of the School of Economics. In the application they were required to provide a brief introduction and background of their financial need. Students were also informed that a committee comprising of the teachers of the same school will conduct interviews of the applicants and only those will be helped, who are recommended by the committee. After visiting most of the classes, the same written instructions were displayed on all the notice boards of the school. The purpose was to ensure that the information reaches all the students who might have been absent during our visit to their classes.[5] Within the due time, we received 11 applications. One may wonder about the small number of applicants. However, the students knew that cheating their own teachers might not be possible; hence only those applied who were really suffering financially. It is worth mentioning that almost all of the applicants were recommended by the committee after interviews. In the applications, the total demanded amount was 342,000 Pakistani rupees (approximately $3420) for one semester.

In the second round we visited the same classes after a week. The main purpose of the second round was to collect pledges from students in order to support those students who had asked for help in the first round. A question might arise here that donors and recipients belong to the same subjects. This was done to make the students realise that the needy were from them; however, the identity of the needy students was not provided. After reading out the written instructions, we provided the pledge forms to the students. The pledge form contained various options. Each student was asked to select an option of his choice and drop it in a large collection box that we had placed in the room. The reason of placing a large collection box was to minimise the experimenter demand effect if any. It is worth mentioning that the size of classes was heterogeneous, hence students could pledge zero without peer pressure. It is also worth mentioning that the students only knew that the pledges are taken to help the needy among them; however, they did not know that they are participating in an experiment as well. In this round, all the students were divided into five treatments. The details of the all 5 treatments are

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[4]All instructions are available in the Appendix.

[5]It is pertinent to mention that there are about 4 Notice boards in the school and the instructions were displayed on all of them.

summarised in Table 1. Each of the treatments differed from the baseline treatment only in terms of the provision of additional information.

In the baseline (BL) treatment we distributed the pledge forms after reading out the written instructions. The students deposited the pledge form in the collection box. In the second treatment named as Pledge Disclosed (PD) treatment, the students were provided additional information about the *average amount of pledge per students in the BL treatment* before submitting their pledges. The additional information in the third treatment, *i.e.* Need Disclosed (ND) treatment, was about the *total need of the students* who had asked for financial help in the first round. In the fourth treatment, *i.e.* Pledge and Need Disclosed (P&ND) treatment, students were asked to make pledges after providing them with the information about *the need as well as the average amount of pledges per students* in all of the previous three treatments. The fifth and final treatment named as All Disclosed (AD) treatment was similar to the fourth treatment except that the students were provided with an additional set of information. The additional information was about a pledge of 200,000 Pakistani rupees ($2000) by the Charity Australia International which is an Australian based charitable organisation.

Table 1

The List of Experimental Treatments

Treatment	Informational Frame	No. of Observations
Baseline (BL)	No prior information about pledges or needs	112
Pledge Disclosed (PD)	Prior information about the average pledge in BL	75
Need Disclosed (ND)	Prior information about the total demand for financial assistance	75
Need and Pledge Disclosed (P&ND)	Prior information about total demand and the average pledge calculated from BL, PD and ND treatments	78
All Disclosed (AD)	Prior information about the history, pledge calculated from all previous treatments, total demand and pledge by Charity Australia International	55

4. THEORETICAL FRAMEWORK AND HYPOTHESES

Based on the assumption that economic agents are selfish, there are at least five distinct theories that explain why one contributes to philanthropic causes. Most of them predict that individual benefits, at least partially, from the philanthropic contribution. The dynastic model of family given by Barro (1974) asserts that individuals appear to act altruistically by passing wealth to their children; however, this philanthropic act is in reality a lateral shift within the family. Thus, it assumes that family rather than the individual is the main unit of analysis. Andreoni (1989) argues that an individual receives a private good of "warm glow" from an act of philanthropy along with more of a public good towards which he/she makes donation. Clotfelter and Steuerle (1981) illustrate that income taxes have a negative effect on the amount individuals contribute to philanthropy. This implies that tax deductibility partially counteracts the discouragement caused by the imposition of that tax. In other words, individuals are willing to make donations only if the price of giving is low enough. Asheim (1991) asserts that individuals consume private goods in conjunction with altruistic giving such that they will only choose a level of

private consumption that is "just". Alternatively, the chosen level must take into consideration the necessity of altruism. Rose-Ackerman (1996) has made an argument similar to Andreoni (1989) in the separation of public and private goods, theorising that individuals give altruistically in order to receive, as a private good, greater social capital in return.

In the design of our experiment, students create public good privately; hence the theories of Andreoni (1989) and Rose-Ackerman (1996) fit more to our design.[6] As mentioned earlier, these studies assert that individuals' donations are like a public good; however, individual donors receive private goods of "warm glow" from their actions. Those who pledge donation in the design of our experiment are not direct beneficiaries; but they are likely to receive "warm glow". Hence, the theories of Andreoni (1989) and Rose-Ackerman (1996) apply to the design of our experiment and we expected positive amount of pledges in all of the five treatments. In addition, the involvement of teachers is also an important factor for the positive amount of pledges as Rose-Ackerman (1986) noted that when a third party (especially the department teacher) acts as a monitor; it improves the information available to donors, making the donors to contribute more.

Next, we discuss the question that how the informational frame affects the level of pledges in different treatments. For instance, the informational frame in the ND treatment is such that we informed the students about the level of the need; however, we did not inform them about the pledges made until that time to meet the required need. The total need was about 342,000 Pakistani rupees (About $3420) based on the applications of 11 needy students that we received in the first round. Hence, considering the total demand, each student in the ND treatment might underscore his pledge and instead of pledging high may pledge low. The studies, based on survey, reveal that when people perceive that their contribution will not make any difference, they are less likely to contribute [Radley and Kennedy (1992); Mathur (1996); Diamond and Gooding Williams (2002); Duncan (2004); Arumi, *et al.* (2005); Smith and McSweeney (2007)]. The individuals, who perceive so, believe in the reasoning of free rider problem [Olson (1965)]. In other words, they think that an additional dollar does not solve the problem; hence, not giving does not make things worse.

In the PD and P&ND treatments we expect crowding-in. The possible justification is that when students see that others give to a charity; they can take this as a signal that others have confidence in the organisers or organisation.[7] In particular, in P&ND treatment, the students can also observe the need; hence, they are more likely to pledge more. This leadership effect is described earlier by social psychologists as a 'modelling effect' [Bryan and Test (1967); Lincoln (1977); Reingen (1982)]. One can argue that the high level of pledges in the ND treatment might force participants to think that their pledges are no longer needed. This is a valid argument, but is less likely in our case, as participants in the PD treatment could not observe whether the need has been satisfied. And participants of P&ND treatments could clearly observe that the pledged amount is less than the need.

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[6] The creation of a pool from where needy students can benefit is like a public good. The production of this public good comes through voluntary contribution. As this public good is run by private organisation (Roshni Trust), hence, we are of the view that students create a public good privately.

[7] In this case, the organisation is Roshni Trust which, as stated earlier, sponsors tuition fees of students in Quaid-i-Azam University, Islamabad.

In the AD treatment, the students are also likely to show crowding-in. The major reason is that a matching offer by a third party "Charity Australia International (CAI)" can have a legitimising effect. Students are likely to think that the third party had enough confidence in the organisation. This may increase the confidence level of the students in the organisation and as a result, they might pledge more. In a field experiment of a health charity, Van der Scheer, *et al.* (1998) found that a signature by a professor in health care research raised donations by 2.4 percent. Similarly, a lab experiment found that observing high status donators leads others to increase their donations. In contrast, the leadership effect was not found when low status individuals were observed as contributors [Kumru and Vesterlund (2002)]. The giving by CAI may also increase the perceived value of giving for students. This is because the students might see themselves in line with the cause endorsed by a party having superior information [Vesterlund (2003)].

Based on the above discussions, we test the following hypotheses in this study:

Hypothesis 1

The pledges per students in the Pledge Disclosed (PD) treatment will be higher while the pledges per students in the Need Disclosed (ND) treatment will be lower than the pledges per students in the BL treatment.

Hypothesis 2

The pledges per students in the Pledge and Need Disclosed (P&ND) as well as in the All Disclosed treatments (AD) will be higher than the pledges per students in the BL treatment.

5. RESULTS

In this section, we present the results of our analysis. First, we will provide an overview of the average pledges in all the treatments. Next, we will discuss the impact of informational frame on the total pledges in each treatment relative to the baseline treatment.

5.1. Descriptive Statistics

The descriptive statistics of the charitable pledges across all the treatments are shown in Table 1. Besides pledges, it also provides the information regarding the number of observations per treatment and the average expenditure of students per semester.[8] The second row in the Table shows the percentage of students in each treatment who have made a positive pledge. As is evident from the Table, this percentage is higher in All Disclosed (AD) treatment. Moreover, the results show that the level of pledges does not increase monotonically as we move from BL to AD treatment. The average pledge in the Baseline (BL) treatment is 434.46 ($4.34) Pakistan rupees. As we provide information on pledge requests, there are different effects with different degrees of information provided. For instance, as the Table shows, the average pledge size decreases in PD and ND treatments while it increases in P&ND and AD treatments.

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[8]Semester in Quaid-i-Azam University generally consists of five months and there are two semesters per year, i.e. fall and spring.

Table 2

Descriptive Statistics of Charitable Pledges across Treatments in PKR
(Where Approximately 100 PKR=$1)

	Baseline (BL)	Pledge Disclosed (PD)	Need Disclosed (ND)	Pledge and Need Disclosed P&ND)	All Disclosed (AD)
Total number of observations	112	75	75	78	55
% of observations with positive pledges	51.78	61.33	56.00	55.13	74.54
The maximum amount of positive pledges	2688	1344	2688	2688	6000
The minimum amount of positive pledges	100	50	50	100	10
Average pledges per semester	434.46	325.07	341.41	522.67	644.62
Average expenditure per semester	32358.6	35167	28773	27063.5	32471.7
Average pledges as a % of average expenditure	1.34	0.92	1.19	1.93	1.98

The results are further elaborated in Figures 1 and 2 where the average pledges across BL, PD, and ND treatments are shown in figure 1 while the average pledges across BL, P&ND, and AD treatments are shown in Figure 2. It can be observed that the average pledges show a downward trend in cases of PD and ND treatments relative to the BL treatment. In contrast, the average pledges in P&ND and AD treatments show an increasing trend relative to the BL treatment. In order to find the justification for these results, we provide the detailed description of each treatment relative to the BL treatment.

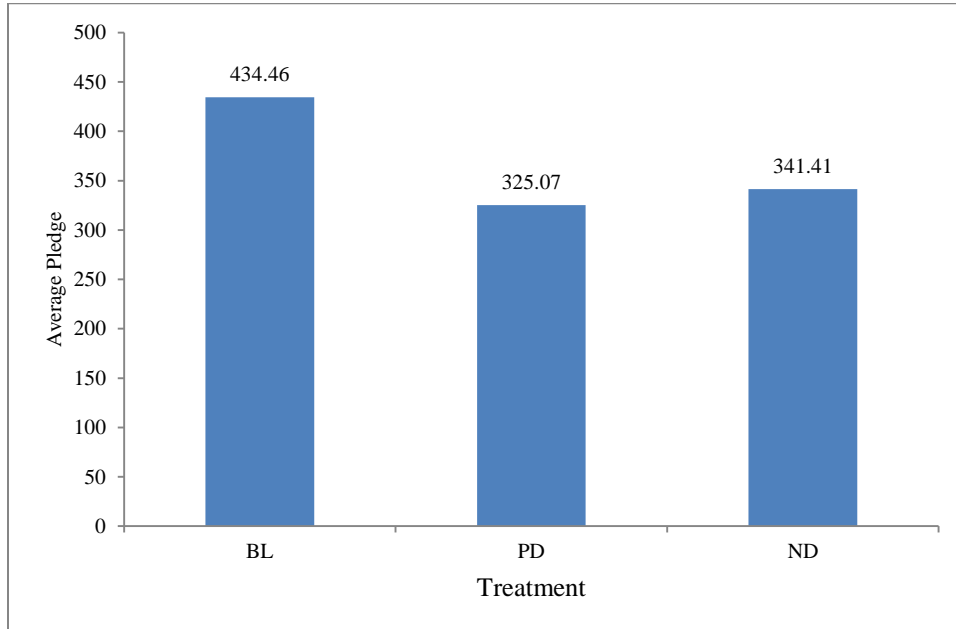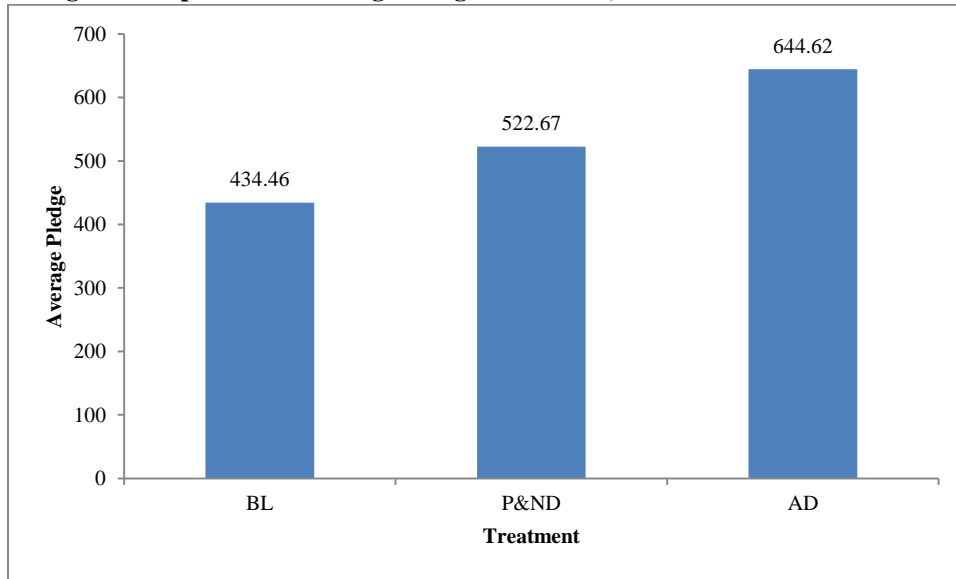**Fig. 1. Comparison of Average Pledges across BL, PD and ND Treatments**

Fig. 2. Comparison of Average Pledges across BL, P&ND and AD Treatments

5.2. Baseline and Pledge Disclosed Treatments

As stated earlier, in the PD treatment, we disclosed the information about the average pledge by the participants in the BL treatment. With the introduction of such a piece of information, the participation ratio increased. For instance, we find that the percentage of participants with positive pledge rises from 51.78 percent in the BL treatment to 61.33 percent in the PD treatment. However, the average pledge decreases in the PD treatment to 325.07 Pakistan rupees which is 434.46 rupees in the BL treatment. Likewise, the maximum pledge in the BL treatment is 2688 rupees which decreases to 1344 rupee in the PD treatment. Similar to the maximum pledge, the minimum level of pledge also decreases from 100 rupees in the BL treatment to 50 rupees in the PD treatment. Taking positive pledge of each participants as an independent observation, Wilcoxon Rank-sum test shows that the distribution of pledges is not similar across both treatments ($p<0.01$).

The fall in the average size of pledge in the PD treatment is against the hypothesis 1. It is astonishing for us as one might have expected an increase in the size of pledge. However, it is possible that the participants in PD treatment might have thought that as others have already made a reasonable amount of pledge, so why not to free ride on their pledges. Second, the other justification for the fall in the average level of pledge in the PD treatment might be the lack of information with regard to the need for donations. In other words, we did not provide information regarding the total need for donations with the pledge request in the PD treatment.[9] Hence, they might have thought that the pledge made in the BL treatment might satisfy the total need. Third, it is also pertinent to mention that we provided information about the amount of average pledge in the BL

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[9]The total need for donations was collected in the first round of the experiment through applications from the applicants.

treatment but did not provide the total number of participants that pledged that amount. In order to justify free riding on the pledges of others, the students in the PD treatment might have overestimated the total number of participants in the BL treatment. Finally, the difference in the sample of students in terms of their incomes across both the treatments might explain the difference in their average level of pledges. This conjecture, however, loses ground when we compare the average expenditure of students across both the treatments.[10] As is evident from Table 2, the average expenditure of students per semester in the BL treatment is 32358.6 Pakistani rupees while in the PD treatment, it is 35167 rupees.

A comparison of the distributions of pledges across BL and PD treatments is shown in Figure 3. As the figure indicates, the number of larger pledges decreases. For instance, the frequency of pledges below 500 rupees is high in the PD treatment as compared with those in the BL treatment. In contrast, the number of larger pledges, in particular over 500 rupees, is more in the BL treatment.

Fig. 3. Distribution of Pledges across BL and PD Treatments
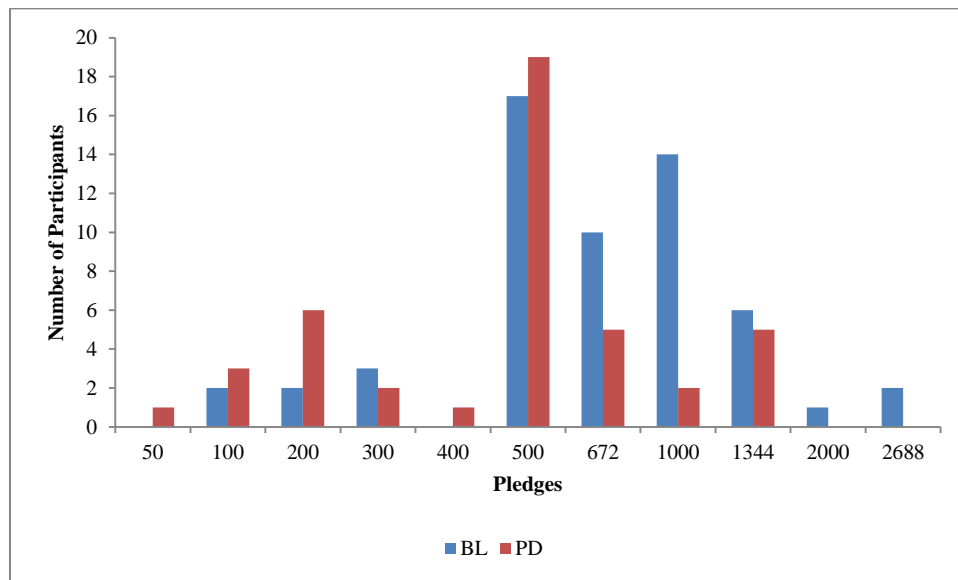
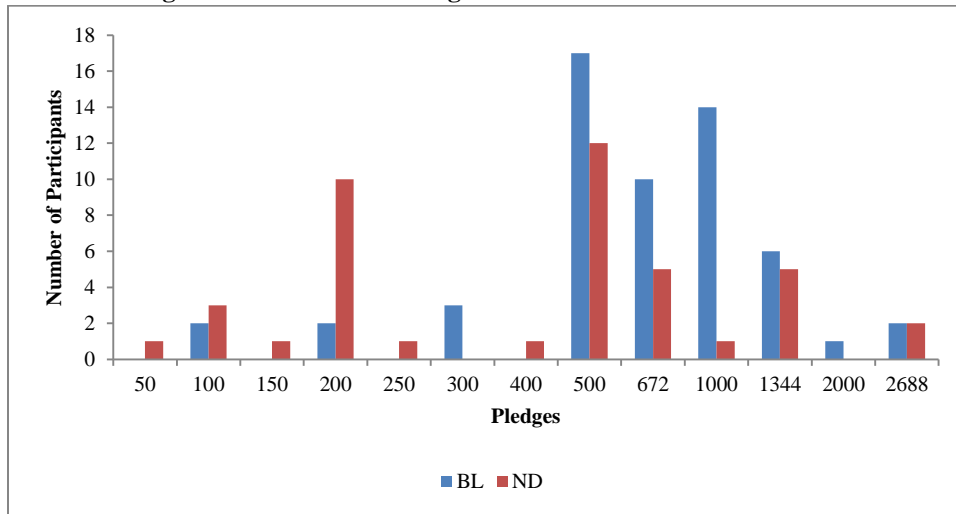### 5.3. Baseline and Need Disclosed Treatment

The rate of Participation in the ND treatment increases to 56 percent from 51.78 percent in the BL treatment. However, the inclusion of additional information in the PD treatment does not seem to have a beneficial effect on the pledge size as is shown in Figure 4.[11] The Figure indicates that the distribution of the pledge size in the ND treatment is mostly lower than the distribution of the pledge size for the corresponding

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[10]The average expenditure per semester can be regarded as a proxy of income as the spending pattern or the spending level is a strong indicator of the level of income.

[11]The additional information was the disclosure of the need of deserving students from round 1 of the experiment.

BL treatment. The number of pledges lower than 500 rupees is more in the ND treatment while the number of pledges greater than 500 rupees is less in the ND treatment. As a consequence, the average pledge in the ND treatment drops to 341.41 rupees from 434.46 rupees in the BL treatment. This translates into a negative effect of the additional information in the form of disclosing the need of deserving students on the average pledge size. For instance, it decreases the average pledge size by 93.05 rupees. If we take positive value of individual pledges as independent observations, the Wilcoxon Rank-Sum test shows that the distribution of pledges in ND treatment is higher than the distribution of pledges in the BL treatment ($p<0.01$). The finding supports hypothesis 2 and substantiates the evidence of earlier studies. For instance, the earlier research establishes that when people perceive that their contribution will not make any difference, they are less likely to contribute [Radley and Kennedy (1992); Mathur (1996); Diamond and Gooding Williams (2002); Duncan (2004); Arumi, *et al.* (2005); Smith and McSweeney (2007)].

**Fig. 4. Distribution of Pledges across BL and ND Treatments**

5.4. Baseline and Pledge and Need Disclosed Treatment

In this treatment, we disclose both the earlier pledge and the total need to the participants. With the introduction of this information, the number of individuals who make positive pledges increases. In addition to the increase in the number of pledge makers, the sizes of the pledges also increase. The average pledge amount is 522.67 Pakistani rupees in the P&ND treatment which is larger than that of the BL treatment by 88.20 rupees. The comparison of the distributions of pledges in the P&ND and BL treatments is shown in Figure 5. It is evident from the Figure that the level of pledge in the P&ND treatment is mostly skewed to the upper tail of the distribution. Also, the level of the highest donation, i.e. 2688 rupees, almost doubles in the P&ND treatment. However, taking positive level of the individual pledges as independent observations, Wilcoxon Rank-Sum test does not show that the distribution of pledges across the two treatments is much different ($p=0.58$).

Fig. 5. Distribution of Pledges across BL and PD Treatments
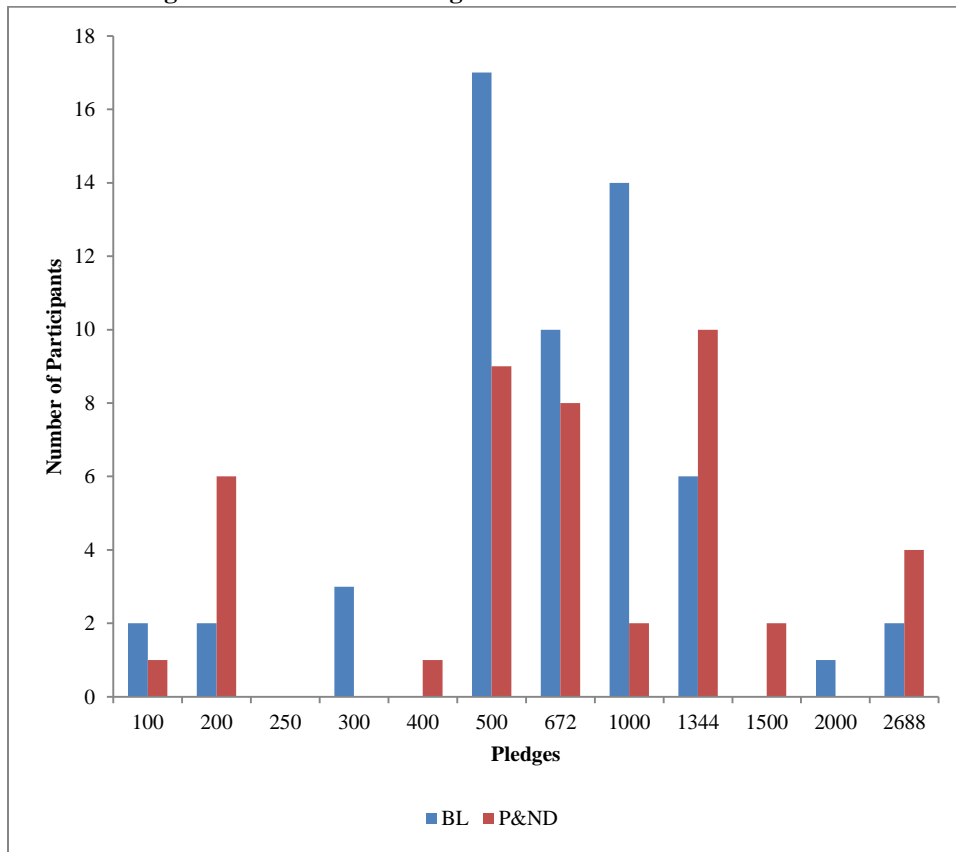
5.5. Baseline and All Disclosed Treatment

In this treatment, all of the previous information was disclosed with the pledge requests. The results are remarkable both in terms of the participation rate and in terms of the size of pledges. Namely, both the participation rate and the size of the pledges increase in the AD treatment. The participation rate increases from 51.78 percent in the BL treatment to 74.54 percent in the AD treatment. Likewise, the average size of pledge increases from 434.46 rupees in the BL treatment to 644.62 rupees in the AD treatment. In the same way, the average donation as a percentage of the average expenditure increases from 1.34 percent in the BL treatment to 1.98 percent in the AD treatment. We expected that the larger number of pledges would be composed mainly of small pledges. However, Figure 6 shows that the level of pledges in the AD treatment is larger than the level of pledges in the BL treatment. A comparison of distributions in Figure 6 also indicates that the absolute number of small donations actually decreases in the AD treatment. Though there were some small pledges ranging from 10 rupees to 50 rupees, but there is also a large pledge of 6000 rupees. This shows that by disclosing all the information, a fund raiser can better achieve the target fund. However, the Wilcoxon Rank-Sum test shows that the distribution of AD treatment is weakly different from the distribution of BL treatment ($p=0.10$).

Fig. 6. Distribution of Pledges across BL and PD Treatments
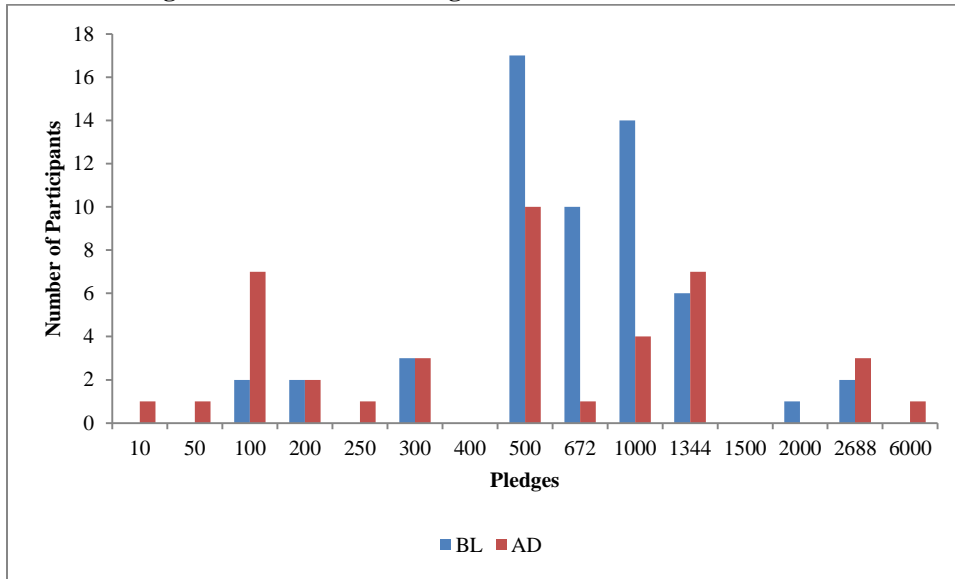
6. CONCLUSION

This study is motivated by the previous literature that emphasises the role of information framing on economic behaviour. Here, we analyse the impact of informational frame on charitable pledges. The study is based on an experiment in a fund raising project named as Helping Students through Students. We solicit pledges from 395 students in the School of Economics, Quaid-i-Azam University, Islamabad. We randomly divide the students into 5 different treatments. In the PD treatment, we provide information to students about the average size of pledge made by students in the BL treatment. Similarly, in the ND treatment, we provide information about the total need of those who had asked for donations in the first round of the experiment. In the P&ND treatment, we inform the students about both the need as well as the pledge made by students in the BL treatment. Finally, in the AD treatment, we provide the details about the need, the pledges made in the BL treatment, the previous history of the project, and the pledge made by the Charity Australia International.

We find an increase in the average level of pledge with the informational frame of disclosing all types of information, i.e. AD treatment. On the other hand, we find the lower size of average pledge in the treatments where we only provide the pledge in the BL treatment or the need of the others, i.e. PD and ND treatments. Moreover, we find substitutability of charitable pledges in the PD treatment while complementarity of charitable pledges in the P&ND and AD treatments. Our finding in the ND treatment is in line with the earlier studies which are based on survey instead of experiments [Arumi, *et al*. (2005); Diamond and Kashyap (1997)].

Our results are of interest for fund-raising practitioners. For instance, our data on pledges show that by providing all information, the fund-raisers can increase the pledge amount. However, the limitation of the study is a possible presence of experimenter demand effect. The reason is that two of the authors are permanent faculty members in

the School of Economics (SOE) where this experiment was conducted. We suspect the presence of the experimental demand effect due to the difference between the pledged and received amount in the account of the trust. It is worth mentioning that the total deposited amount was less than the pledged amount till the due time given to students and the final submission of this paper. Future research can explore whether findings of our experiment will change if campaign is run by aliens in the SOE or the same experimenters run campaign in other departments without disclosing their designations. Likewise, it will be interesting to know whether the amount of pledge changes if participants had to disclose their identity or if they are informed about the tracking of their pledges.

APPENDIX A

HELPING STUDENTS THROUGH STUDENTS

INSTRUCTIONS FOR THE RECEIPENTS

We know that there are many students in QAU who need financial help for pursuing their studies smoothly. Howerver, their ego and self-respect discourage them to ask for help and support. On the other hand, there are many students who are willing to help such needy stdudents, but are unable to find them due to time and information constraints. In the jargons of economics there exists demand and supply for help however, market forces are unable to match them efficently.

We (myself and some alumani of QAU) have started a project named "Helping Students Through Students" to bridge this gap and link the donors students with the needy students.[12] In this regard we have registered a Trust named "ROSHNI TRUST" with the government of Pakistan under 1882 trust act. After formal registration of the trust and opening an account on the name of ROSHNI TRUST in Askari Bank QAU branch, we are for the first time launching a compaign to help students through students. The compaign has two objectives.

(1) Raising fund from students in this semester and transferring the same fund to needy students in the next semester.
(2) Doing a systemtic analysis of the compaign for research purposes
(3) In the first round of the compaign we need information about deserving students. If you think that you need financial support next semester from this project of "Helping Students Through Students", then kindly provide us the following details on a plain page.

- Name
- Father's Name
- CNIC No.
- Email:
- Contact No.
- Per month need in the next semester (Feburary to June 2014)

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[12]My Name is Dr Anwar Shah, Assistant Professor in the School of Economics QAU.

- Brief details of the background due to which you need financial support next semester

We assure that the provided information will remain confidential and never be disclosed. We will try our best that the self-respect of the students is not compromised. Please send us the required information on the following address:

Dr Anwar Shah
Assistant Professor, School of Economics, Quaid-i-Azam University, Islamabad.

You can also submit your sealed enevelop after writing the above full adress at the front desk of School of Economics. The deadline for sending your details is Monday 25 November 2013. You will receive a confirmation email or text once we receive your details.

Note: The final selection will be made by a committee

HELPING STUDENTS THROUGH STUDENTS

INSTRUCTIONS FOR THE DONORS

We know that there are many students in QAU who need financial help for pursuing their studies smoothly. Howerver, their ego and self-respect discourage them to ask for help and support. On the other hand, there are many students who are willing to help such needy stdudents, but are unable to find them due to time and information constraints. In the jargons of economics there exists demand and supply for help however, market forces are unable to match them efficently.

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(1) Raising funds from students in this semester and transferring the same funds to needy students in the next semester.
(2) Doing a systemtic analysis of the compaign for research purposes

To day we are running the second round of this compaign. In this round we ask you for donations in the form of pledges. Once we receive your pledges, we will add them up and after due scrutiny pass them on to the deserving students. Priority will be given to the deserving students from the school of economics. We will appreciate, if you could indicate a deserving student whom you would like your money to be passed on. All information regarding your donations and the students whom you would like to sponsor will not be disclosed in any platform without your prior approval.

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[13]My Name is Dr Anwar Shah, Assistant Professor in the School of Economics QAU.

We will urge you to ensure that your pledge amount reaches to the account of Roshni Trust before 30 December 2013. Please note that your pledge is completely voluntary hence avoid making a pledge which you cannot pay by the due date. If the promised amount will not be received by the due date, we will be unable to start processing the applications of needy students. Hence you are urged again to make realistic pledge and transfer it to the account of Roshni Trust before the deadline with in due time.

Following is the details of the account of ROSHNI TRUST.

Title of Account: Roshni Trust
Account Number: 1500 39000 4256
Bank: Askari Bank Limited
Branch: Quaid-i-Azam University Islamabad
Swift: ASCMPKKA

HELPING STUDENTS THROUGH STUDENTS

A WELFARE PROJECT OF ROSHNI TRUST
PLEDGE FORM

Please encircle one option from the list (A to E) given below

(A) I want to sacrifice two cups of tea per day and donate 12*2*(16*7)= 2688
(B) I want to sacrifice one cup of tea per day and donate 12*1*(16*7)= 1344
(C) I want to sacrifice half a cup of tea and donate 6*1*(16*7)= 672
(D) I want to contribute Rs------------------- (write down the amount)
(E) I wish to contribute; however, my budget constraint is low at the moment so cannot make a pledge

Note: In option A to C, the amount of pledge has been calculated assuming 16 weeks of teaching per semester.

Please fill the following brief survey

- Your Gender
    Male
    Female
- How much is your approximate montly expenditure in the university: Rs   -------
- Who supports your above mentioned monthly expenditure?
    Parents
    Rrelatives
    Friends
    Others ------------------ ---------------------- (Please mention)
- Would you like to disclose your name?
    Yes
    No
- If yes, then please write your name:-----------------------------

- Would you like a reminder for submitting your pledge before one week of the
  due date
  - Yes
  - No
- If Yes please give us your email and contact number:
  - Email:
  - Contact No.
- Would you like to name the students whom your donation is to be transferred?
  - Yes
  - No

If Yes, then please mention the name, semester and class of such student

Name:--

Semester:---------------------------------   Class: BS/MSs/MPhil

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New Keynesian Macroeconomic Model and Monetary Policy in Pakistan

SHAHZADA M. NAEEM NAWAZ and ATHER MAQSOOD AHMED

The New Keynesian (NK) models have advantage over the Real Business Cycle (RBC) models as they allow rigidities in the structure of the model, hence provide built-in mechanism to incorporate the structural shocks. The estimation of the NK model for Pakistan's economy remains a relatively unexplored area. This study attempts to estimate a closed economy version of the NK model using robust econometric technique. On the empirical side macroeconomic dynamics have been investigated in response to unanticipated monetary shock. The reaction of the monetary authority (the State Bank of Pakistan) in response to structural shocks has been assessed by exploring the role of forward looking expectations. The SVAR model has been employed to estimate the structural parameters. The response of macroeconomic aggregates to structural shocks has also been simulated along with discussing the forecast error variance decomposition. The role of forward looking expectations is found to play prominent role in the prevailing market structure of the country. The State Bank of Pakistan (SBP) has been found to respond to shocks after a lag of one or more periods indicating time inconsistency problem which is due to discretionary monetary policy stance being adopted by the monetary authority. The distorted beliefs of economic agents about the stance of monetary policy have pointed towards weak effectiveness of the monetary policy. The results suggest that the SBP would have to adopt an independent and transparent monetary policy by following some sort of Taylor-type rule.

JEL Classification: C32, C51, E52, E58
Keywords: New Keynesian Models, Real Business Cycle Models, Forward Looking Expectations, SVAR Model, Price Puzzle

1. INTRODUCTION

The macroeconomic models of the 1970s were heavily criticised due to lack of theoretical foundations.[1] The New Keynesian (NK) models of today have vastly improved the earlier versions as they include the role of expectations of economic agents and require policy makers to incorporate the role of expectations to attain macroeconomic stability. These models have the advantage over the Real Business Cycle (RBC) models as they allow rigidities in the structure of the model, hence provide built-in mechanism to

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[1]See the extensive work of 1970s of such luminaries as Lucas, Barro, Sargant, and Wallace.

incorporate the structural shocks. The theoretical model developed in the present study resembles to most of the closed economy Dynamic Stochastic General Equilibrium (DSGE) models that emphasise the importance of inter-temporal optimisation behaviour of economic agents, the role of forward looking expectations and nominal price rigidities. The four main objectives of the study are as follows. First is to investigate the macroeconomic dynamics in response to unanticipated monetary shock in the presence of rigidities in the goods and labour markets; second, to assess the reaction of monetary authority (the State Bank of Pakistan) to structural shocks; third to highlight the importance of forward looking expectations of economic agents in policy-making; and finally the identification of sources of variations in the macroeconomic aggregates.

This paper takes the lead over others as the rational expectations NK model has been estimated through maximum likelihood estimation procedure—a pioneering attempt in Pakistan. The identification scheme applied is unique in the sense that it has not been adopted earlier for modeling the Pakistan's economy. We have also attempted to implement the expectations type Taylor rule which provides an insight to the policy makers to target inflation and output gap in order to stabilise the economy. The estimation proceeds in two steps, following Keating (1990) who categorised this approach as the SVAR model. The impulse response analysis has been conducted which provides a valuable insight into the significance of structural shocks to the macroeconomic dynamics of the economy. Forecast error variance decomposition has also been computed which has the advantage to identify the sources of variation in the macroeconomic aggregates.

The results seem to confirm that the SBP has been pursuing discretionary policy rather than adopting any rule. This has been observed by examining the structural parameter estimates of the interest rate rule and the response of interest rate to the structural shocks. These findings highlight the role of expectations and the need for incorporating the direct and indirect impacts of factors which affect the macroeconomic dynamics. It, therefore, provides an insight to the policy-makers to achieve the short term and medium term targeted levels of inflation and economic growth in a more effective manner.

The paper is arranged as follows. Section 2 presents the closed economy model under rational expectations. Section 3 derives the identifying restrictions based on the structural macroeconomic model along with discussing the methodology. Section 4 presents and discusses the estimated results. Finally, Section 5 concludes the discussion, derives policy implications, and also suggests the scope for future research in the area of macroeconomic modeling for Pakistan.

2. FRAMEWORK OF FORWARD LOOKING MACROECONOMIC MODEL

One important aspect missing in the non-DSGE macroeconomic models is the lack of microeconomic foundations and nominal rigidities. In essence, the requirement is to develop a structural model which is free from such criticism and could be useful for policy analysis. Before we start discussing the model it is important to acknowledge the work of Haider and Khan (2008) and Ahmed, *et al.* (2012) that have worked on the structure of DSGE model. Both these studies have, however, 'managed' the

unavailability of microeconomic parametric values by relying on 'borrowed' values from the countries other than Pakistan.

We start with the final equations of the closed economy version of the model presented by Clarida, *et al.* (1999) which consists of three main economic agents. First, the households who generate demand for goods and services hence provide aggregate demand equation (forward looking IS equation). Second, the profit maximising firms who provide forward looking Phillips curve equation (aggregate supply equation) and the third is the central bank that follows the Taylor type interest rate rule. We discuss these three components briefly.

2.1. Aggregate Demand Equation

Expectations type aggregate demand equation derived through the optimum behaviour of the household can be expressed as

$$x_t = -\varphi[i_t - E_t\pi_{t+1} - \rho] + E_t x_{t+1} + \epsilon_t^f \quad \ldots \qquad \ldots \qquad \ldots \qquad \ldots (2.1)$$

The equation is obtained through log-linearising the Euler equation of consumption after imposing condition that consumption expenditure equals output minus government purchases. Since ϵ_t^f depends on expected changes in government purchases relative to expected changes in potential output, hence it shifts the IS curve. Therefore it is named as demand or fiscal shock.[2] The parameter φ represents inter-temporal elasticity of substitution and ρ is the time discount factor.

This forward looking IS equation shows that domestic output gap depends inversely on the real interest rate $[i_t - E_t\pi_{t+1} - \rho]$, that is, it reveals that with the rise in real interest rate consumers will save more which, in turn, will result in reduction in aggregate spending. The central bank can influence the consumption pattern of households through changes in the nominal interest rate, which results in changes in the real interest rate due to sluggish changes in the prices. The domestic output gap is directly determined by the future output gap expected in the current period $(E_t x_{t+1})$. ϵ_t^f is the disturbance term which obeys: $\epsilon_t^f = \mu\epsilon_{t-1}^f + \hat{e}_t$; $0 \leq \mu \leq 1$ and $\hat{e}_t$ is i.i.d. random variable with zero expected value and constant variance.

2.2. Aggregate Supply Equation

The nature of inflation dynamics, which is the most distinctive feature of the new Keynesian paradigm, is captured by the New Keynesian Phillips Curve which is based on

[2] $\hat{c}_t = E_t\hat{c}_{t+1} - \frac{1}{\sigma}(\hat{i}_t - E_t\pi_{t+1} - \rho)$

$y_t = \hat{c}_t + g_t$ as investment is suppressed. Thus $y_t - g_t = \hat{c}_t$ and $\hat{c}_{t+1} = y_{t+1} - g_{t+1}$

$$y_t = E_t(y_{t+1} - g_{t+1}) - \left(\frac{1}{\sigma}\right)(\hat{i}_t - E_t\pi_{t+1} - \rho) + g_t$$

$$y_t = E_t(y_{t+1}) - \left(\frac{1}{\sigma}\right)(\hat{i}_t - E_t\pi_{t+1} - \rho) - E_t(g_{t+1} - g_t)$$

Using $x_t \equiv y_t - y_t^p$, where x_t is output gap, y_t is the actual output and y_t^p is the potential level of output. The above equation can be written as

$$y_t - y_t^p = E_t(y_{t+1} - y_{t+1}^p) - \left(\frac{1}{\sigma}\right)(\hat{i}_t - E_t\pi_{t+1} - \rho) + E_t(y_{t+1}^p)$$

$$x_t = -\varphi[i_t - E_t\pi_{t+1} - \rho] + E_t x_{t+1} + \epsilon_t^f$$

Calvo's (1983) model. According to this model inflation is determined by expected future inflation and firm's real marginal costs. The literature on the New Keynesian Phillips Curve is focused on two main issues: First, what measures can be appropriate in order to account for real activity. Second, expectations are a crucial element that can affect the results. The relation of inflation, evolved from the Calvo model, is of the following form $\pi_t = \lambda \widehat{mc}_t + \beta E_t \pi_{t+1}$. Following Clarida, *et al.* (2001), cost push shock can be added with the marginal cost which represents the imperfections in the labour market. Thus, $\widehat{mc}_t = \frac{N_t^\varphi}{C_t^{-\sigma}} e^{\epsilon_t^c}$, log-linearising and solving gives us the following relationship $\widehat{mc}_t = \lambda_0 x_t + \epsilon_t^c$; where λ_0 represents output elasticity of real marginal cost. The aggregate supply equation, derived from the optimising behaviour of firms can be transformed as under:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda_0 x_t + \epsilon_t^c \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \ (2.2)$$

This equation shows that inflation (π) depends on inflation expectations and domestic output gap (x_t) and $\boldsymbol{\epsilon_t^c}$ is the cost-push shock, which can be described by $\epsilon_t^c = \mu \epsilon_{t-1}^c + \hat{e}_t$. Inflation expectations play a central role in the Phillips curve models. For long time horizons, inflation expectations may be a sign of a monetary authority's credibility to fulfil the commitment to price stability.

2.3. Forward Looking Monetary Policy Rule

Central banks target inflation and output gap to stabilise the economy by adjusting the interest rate which results in changes in real interest rate due to price rigidity. The interest rate reaction function is derived by inserting the reduced form of output gap in the aggregate demand equation and solving it for the nominal interest rate.

$$i_t = \gamma_3 + \gamma_1 (E_t \pi_{t+1}) + \gamma_2 x_t + \epsilon_t^i \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \ (2.3)$$

There is now a general acceptance for policy rule instead of discretionary policy to improve the economic performance. In this regard, the seminal paper by Barro and Gordon (1983) is a classic example where the time inconsistency associated with discretion rather than rule has been highlighted. Among others, Walsh (1995) has also argued for an independent central bank for reducing the inflationary bias. To circumvent this bias, Taylor (1993) formulated a very simple and practicable rule necessitating changes in short term policy rate in response to changes in inflation and output gap. It requires that the parameters of inflation and output gap should be positive. However, Taylor (1999) suggested more than one-to-one adjustment in policy rate due to changes in inflation and the parameter for output gap should not fluctuate significantly from 0.5 which otherwise indicates instability of the system. On the other hand if parameter values are negative then it simply shows that the central bank is not following the Taylor Rule and instead there is a satiation for discretionary monetary policy. There is evidence to prove that lack of transparency in policy deteriorates macroeconomic performance rather than improving it.

3. METHODOLOGY AND IDENTIFICATION
OF RESTRICTIONS

Both DSGE and SVAR models have emerged after the failure of large scale models in the 1970s. Whereas the DSGE models have been developed on the basis of

strong assumptions about the functional forms, exogeneity, market structure and dynamic structure of the constraints, the SVAR models were initially proposed with minimal restrictions on the dynamics of the endogenous variables. However, they impose cross equation restrictions so that models are robust enough to capture the true structure of the economy in comparison with the alternative ad hoc models. Gali (1999) viewed the SVAR models as informative as the DSGE models.

The fundamental departure from traditional to micro-based models started when Lucas (1976) presented his famous critique. In a drastically changed paradigm, today the emphasis is on micro-foundations in a forward looking environment. The models now rely on utility and profit functions of economic agents who formulate and reformulate their expectations as and when there are changes in the policy by government or the central bank. These changes in the expectations result in poor guides for the policy makers to evaluate the new regime thus there is need to estimate the deep structural parameters which have the feature of being invariant to policy changes. Such models with rational expectations, derived through optimisation by the agents, have the ability to identify the rational expectations restrictions. As indicated in the introduction, Keating (1990) has proposed a two steps procedure for estimating the structural model having forward looking components and named it as SVAR model. The procedure, prescribed by Keating (1990), facilitates the researchers to make the SVAR and DSGE models compatible. Impulse response functions and variance decomposition can also be generated using the restrictions and the model is named as structural VAR model. Following the procedure to identify the restrictions, the structural model is converted into a representation comprising the structural shocks and the residuals of unrestricted VAR model along with structural parameters. Forward looking expectations are formulated through innovations of the dynamic economic structure.

3.1. Identification of Restrictions

The complete DSGE model conforming to the NK framework for a closed economic environment, discussed in the previous section, is reproduced below.

$$x_t = -\varphi[i_t - E_t\pi_{t+1} - \rho] + E_tx_{t+1} + \epsilon_t^f \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.1)$$

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda_0 x_t + \epsilon_t^c \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.2)$$

$$i_t = \gamma_3 + \gamma_1(E_t\pi_{t+1}) + \gamma_2 x_t + \epsilon_t^i \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.3)$$

Subtracting all variables in the above equations from their expected values at time $t-1$ yield the following set of equations

$$x_t - E_{t-1}x_t = -\varphi(i_t - E_{t-1}i_t) + \varphi(E_t\pi_{t+1} - E_{t-1}\pi_{t+1}) + (E_tx_{t+1} - E_tx_{t+1}) + \epsilon_t^f \quad (3.4)$$

$$\pi_t - E_{t-1}\pi_t = \beta(E_t\pi_{t+1} - E_{t-1}\pi_{t+1}) + \lambda_0(x_t - E_{t-1}x_t) + \epsilon_t^c \quad \dots \quad \dots \quad (3.5)$$

$$i_t - E_{t-1}\pi_t = \gamma_1(E_t\pi_{t+1} - E_{t-1}\pi_{t+1}) + \gamma_2(x_t - E_{t-1}x_t) + \epsilon_t^i \quad \dots \quad \dots \quad (3.6)$$

In the above equations, $y_t - E_{t-1}y_t$ for all the variables represent the respective reduced form residuals. However, $(E_t\pi_{t+1} - E_{t-1}\pi_{t+1})$ and $(E_tx_{t+1} - E_{t-1}x_{t+1})$ are the forward looking components in the model and need to be estimated on the basis of

contemporaneous observations of the variables. The procedure to calculate these forward looking components is elaborated as follows:

$$
\begin{bmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ \vdots \\ y_{t-q+1} \end{bmatrix} = \begin{bmatrix} A_1 & A_2 & \cdots & \cdots & A_q \\ I_n & 0_n & \cdots & \cdots & 0_n \\ 0_n & I_n & 0_n & \cdots & 0_n \\ \vdots & \vdots & \ddots & \ddots & \vdots \\ 0_n & \cdots & 0_n & I_n & 0_n \end{bmatrix} \begin{bmatrix} y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ \vdots \\ y_{t-q} \end{bmatrix} + \begin{bmatrix} I_n \\ 0_n \\ 0_n \\ \vdots \\ 0_n \end{bmatrix} e_t \quad \cdots \qquad \cdots \qquad \cdots \quad (3.7)
$$

$$
Y_t = AY_{t-1} + Qe_t \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.8)
$$

One step conditional expectation of Equation (3.8) can be written as follows.

$$
E_t Y_{t+1} = AY_t \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.9)
$$

It may be considered that the expected value of residuals is equal to zero, i.e. $E_t(e_t) = 0$.

As Y vector consists of all the endogenous variables, therefore to locate the variables of interest, i.e., output gap and inflation, there is a need to introduce vectors of length nq where n denotes the number of endogenous variables and q denotes their lag order.

$$\acute{r}_x = (1,0,0, \dots ,0) \text{for the output gap}$$
$$\acute{r}_\pi = (0,1,0, \dots ,0) \text{for inflation}$$

Pre-multiplying Equation (3.9) with the above vectors results in the following expected values of forward looking output gap and inflation.

$$
E_t x_{t+1} = \acute{r}_x AY_t
$$

$$
E_t \pi_{t+1} = \acute{r}_\pi AY_t \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.10)
$$

$$
E_t x_{t+1} = a_{11}^x x_t + a_{12}^x \pi_t + a_{13}^x i_t \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.11)
$$

$$
E_t \pi_{t+1} = a_{11}^\pi x_t + a_{12}^\pi \pi_t + a_{13}^\pi i_t \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.12)
$$

It helps us to calculate the expectations revision process for output gap $(E_t x_{t+1} - E_{t-1} x_{t+1})$ and inflation $(E_t \pi_{t+1} - E_{t-1} \pi_{t+1})$.

$$
E_t x_{t+1} - E_{t-1} x_{t+1} = \acute{r}_x A(Y_t - E_{t-1} Y_t)
$$

$$
E_t x_{t+1} - E_{t-1} x_{t+1} = a_{11}^x (x_t - E_{t-1} x_t) + a_{12}^x (\pi_t - E_{t-1} \pi_t)
$$
$$
+ a_{13}^x (i_t - E_{t-1} i_t) \quad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.13)
$$

$$
E_t \pi_{t+1} - E_{t-1} \pi_{t+1} = \acute{r}_\pi A(Y_t - E_{t-1} Y_t)
$$

$$
E_t \pi_{t+1} - E_{t-1} \pi_{t+1} = a_{11}^\pi (x_t - E_{t-1} x_t) + a_{12}^\pi (\pi_t - E_{t-1} \pi_t)
$$
$$
+ a_{13}^\pi (i_t - E_{t-1} i_t) \quad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.14)
$$

Putting values of $(E_t x_{t+1} - E_{t-1} x_{t+1})$ and $(E_t \pi_{t+1} - E_{t-1} \pi_{t+1})$ in Equations (3.4)-(3.6) results in the following set of equations

$$
x_t - E_{t-1} x_t = -\varphi(i_t - E_{t-1} i_t) + \varphi\big(\acute{r}_\pi A(Y_t - E_{t-1} Y_t)\big)
$$
$$
+ \big(\acute{r}_x A(Y_t - E_{t-1} Y_t)\big) + \epsilon_t^f \qquad \cdots \qquad \cdots \qquad \cdots \qquad \cdots \quad (3.15)
$$

$$\pi_t - E_{t-1}\pi_t = \beta(\acute{r}_\pi A(Y_t - E_{t-1}Y_t)) + \lambda_0(x_t - E_{t-1}x_t) + \epsilon_t^c \quad \dots \quad \dots (3.16)$$

$$i_t - E_{t-1}i_t = \gamma_1(\acute{r}_\pi A(Y_t - E_{t-1}Y_t)) + \gamma_2(x_t - E_{t-1}x_t) + \epsilon_t^i \quad \dots \quad \dots (3.17)$$

Now the next step is to replace the values of $(E_t x_{t+1} - E_{t-1}x_{t+1})$ and $(E_t\pi_{t+1} - E_{t-1}\pi_{t+1})$ from Equations (3.13) and (3.14) in Equations (3.15)-(3.17) which yield the required rational expectation restrictions. The structural model based on economic theory corresponds to structural representation of structural shocks and reduced form innovations with reduced form and structural parameters. Therefore, explicit representation of restrictions on the structural parameters is not required as the derived rational expectations restrictions are entirely based on dynamic structural representation of the economy which is in line with Keating (1990). These restrictions are being used to estimate the dynamic closed economy structural VAR model through maximum likelihood procedure in the next section.

4. ESTIMATION AND ANALYSIS

The model is estimated by using quarterly data for the period starting from first quarter of 1993 to fourth quarter of 2013. The output gap is calculated by adopting its basic definition, i.e., the differential between log of actual real GDP and potential GDP. There are various methods to get potential GDP, e.g. it can be measured by regressing the log of real GDP on its trend or by the HP filter. Following Malik (2007), we have used the former approach. Data for quarterly GDP is based on estimates provided by Arby (2008) and Hanif, *et al.* (2013). The data for annual GDP (at constant US$ with base year 2005-06) is taken from WDI (2014) and the Economic Survey of Pakistan. CPI inflation is calculated using log of CPI adjusted for quarterly chain base method. The call money rate (i) is used as a measure for interest rate. Data for CPI and call money rate are taken from IFS (2014) wherein few observations for the year 2013 are picked from official website of the IMF.

To employ maximum likelihood estimation procedure through structural VAR model, we need to incorporate the estimated values of reduced form parameters and residuals' series for the restrictions identified on the basis of structural model, as derived in the previous section. According to Canova (2007), VAR model is appropriate to employ even if the variables are non-stationary. Consistent parameter estimates are obtained even if unit roots are present in the variables [Sims, Stock, and Watson (1990)]. Following Sims, *et al.* (1990) and Sims (1992), the cointegration test is applied here to investigate the long run relationship between variables for which unit root test for all variables is a pre-requisite.

The primary condition for employing unrestricted VAR model is to ensure the stationarity of all the variables at first difference (variables need to be I(1)). Considering the fact that we are using quarterly data, the Augmented Dickey Fuller test (ADF test) has low power to capture the potential seasonal unit roots and non-linearity in the data series, therefore, HEGY test, proposed by Hylleberg, Engle, Granger and Yoo (1990) is used to check the unit roots. This test has the advantage to pretest data before seasonal adjustment or to use data without seasonal adjustment [Charemza and Deadman (1997)]. Since seasonal adjustment can result in loosing information about peak and trough in the data series, therefore it is not advisable in models which are based on economic theory. The results are presented in Table 1.

Table 1

The HEGY Test Results

Variable	Auxiliary Regression	t-test for H_0: $\pi_1 = 0$ (Non-seasonal/Zero Frequency)	t-test for H_1: $\pi_2 = 0$ (Biannual Unit Root)	F-test for H: $\pi_3 = \pi_4 = 0$ (Annual Unit Root)
Output Gap	With Intercept and Seasonal Dummies	−1.69	−2.64**	9.79***
	With Intercept, Time Trend and Seasonal Dummies	−1.68	−2.64**	9.64***
Interest Rate	With Intercept and Seasonal Dummies	−1.84	−4.18***	36.42***
	With Intercept, Time Trend and Seasonal Dummies	−1.83	−4.14***	35.01***
Inflation	With Intercept and Seasonal Dummies	−1.75	−3.56**	20.67***
	With Intercept, Time Trend and Seasonal Dummies	−1.98	−3.56**	20.17***

The results indicate that we cannot reject the presence of unit root at zero frequency in all variables. However for seasonal frequencies, there is no evidence of unit roots. Thus we can safely conclude that the variables are I(1). The residuals for all the auxiliary regressions were found to be white noise.

Based on the results produced by AIC, FPE, LM, lag length is set to be 5. Although SC and HQ support lag length of 4 but it is ignored due to the presence of autocorrelation in the residuals of reduced form VAR model.

To empirically analyse the long run relationship between the macroeconomic aggregates (the output gap, inflation and interest rate), we have used the Johansen and Juselius's (1990, 1992, 1994) system cointegration test. It has the advantage of utilising all available information in the data set, thereby increasing reliability of the estimates. Gonzalo (1992) has shown that the Johansen's maximum likelihood techniques perform better in finite samples than the univariate methods. It also does not rely on arbitrary normalisation Engle and Granger's (1987) method. Test results, presented below show that all the variables are cointegrated which means that a long run relationship exists among all the variables.

Once the reduced form VAR model is estimated, the residuals need to be statistically adequate. For the purpose, diagnostic tests are required to test the hypothesis of no autocorrelation, no heteroskedasticity, and normality. The results show that there is no evidence of serial correlation and heteroskedasticity even at 99 percent level of significance.[3]

[3]The results of reduced form VAR model and Diagnostic tests can be shared, if required.

Table 2

The Cointegration Test Outcome

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.278671	41.05337	29.79707	0.0017
At most 1	0.141998	15.24723	15.49471	0.0545
At most 2	0.039070	3.148429	3.841466	0.0760

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.278671	25.80615	21.13162	0.0102
At most 1	0.141998	12.09880	14.26460	0.1070
At most 2	0.039070	3.148429	3.841466	0.0760

4.1. Maximum Likelihood Structural Parameter Estimates

Conventionally, VAR studies along with studies based on DSGE framework focus on the mutual relationships of the endogenous variables (impulse response functions) rather than estimating structural parameters.[4] The structural parameter estimates are discussed here to show the dimension and magnitude of the impact of different independent variables on the dependent endogenous variable (in the specific macroeconomic relationship) in simultaneous equations system. These estimates also help to understand the macroeconomic dynamics in response to different structural shocks.

The transformation of endogenous variables and identifying restrictions are largely different from the previous studies that have used macroeconomic data for Pakistan. The reason could be that none of these studies have estimated the NK macroeconomic model through maximum likelihood estimation method. In this perspective, the estimated parameters are not comparable with any of the previous studies of Pakistan. Nonetheless, the results are consistent with the literature. The structural parameters estimated through maximum likelihood estimation are presented in Table 3.

All the parameters are significantly different from zero which reflects the significant impact of the variables on the corresponding dependent variables. In the aggregate demand equation, φ (the elasticity of inter-temporal substitution in consumption by the households) is significant even at 99 percent significance level which shows that reduction in real interest rate $[i_t - E_t \pi_{t+1}]$ increases the aggregate demand. The finding is in consonance with the theory expounded by Gali and Gertler (2007) along with others.

The parameter of forward looking inflation (β) in the Phillips curve equation has a value of 0.7362 which indicates that agents place larger weight to future expected inflation than inflation of past periods. This outcome is in line with the findings of Cho and Moreno (2002) and Gali and Gertler (1999). Finally, λ_0 indicates the effect of output gap on the inflation dynamics of the country.

[4]According to Joiner (2002), this is due to the underlying feature of the impulse responses to reflect the dynamic response of macroeconomic variables and that structural parameters do not reflect the dynamics.

Table 3

The Maximum Likelihood Structural Parameter Estimates

	Coefficient	Std. Error	z-Statistic	Prob.
φ	0.178022	0.002399	74.21324	0.0000
β	0.736175	0.000416	1770.512	0.0000
λ_0	–0.002851	0.000663	–4.303656	0.0000
γ_1	–4.828962	0.014359	–336.2983	0.0000
γ_2	1.440747	0.019326	74.55026	0.0000

$$x_t = -\varphi[i_t - E_t\pi_{t+1} - \rho] + E_t x_{t+1} + \epsilon_t^f$$
$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda_0 x_t + \epsilon_t^c$$
$$i_t = \gamma_3 + \gamma_1(E_t\pi_{t+1}) + \gamma_2 x_t + \epsilon_t^i$$

While majority of the literature for developed countries [including that of Gali and Gertler (2007)] confirm positive impact of output gap on inflation in the short run. The output gap may, however, have a negative impact on inflation for the developing countries like Pakistan where Central Banks deal with the dual mandate of not only controlling inflation but also achieving high economic growth in the country Akbari (2005). The negative impact of output gap on inflation, as is obtained in our estimated model, shows that economic growth is inflation reducing. It is not surprising to see the negative sign for the estimated parameter of inflation and positive sign of output gap (with more than one-to-one adjustment) in the interest rate rule because SBP has never claimed to follow the Taylor rule. The negative impact of inflationary expectations on the interest rate shows that the policy was both ineffective and not independent. The positive impact of output gap on interest rate, with more than one-to-one adjustment, indicates that SBP has mainly targeted high economic growth in the country during the period of estimation. One possibility could be that the economy enjoyed a relatively better growth during this period due to external factors and the authorities in the SBP allowed this momentum to continue. This is also evident from the work of Malik and Ahmed (2010). They have found that the SBP has not followed a rule based policy in the past and the preference has always been for discretionary policy, which at times was accommodating in nature, notwithstanding the inflationary pressure.

4.2. Impulse Response Functions

From policy perspective it is important to know the impact of various macroeconomic shocks on key macro aggregates. The literature reveals that monetary policy affects the economy with lag(s) and also generates variability and uncertainty about target achievement. It forces the monetary authority to be forward looking to take necessary steps to stabilise the economy. The study focuses on two sets of Impulse responses—the response of macroeconomic variables to a monetary policy shocks and the response of interest rate (call money rate) to macroeconomic variables. We have also analysed the impact of fiscal shock and aggregate supply shock to complete the discussion. One standard deviation shock is applied and 95 percent confidence bands of the standard errors are projected using the analytical framework.

4.2.1. *Contractionary Monetary Policy Shock*

An unanticipated contractionary monetary policy shock in the shape of an increase in call money rate has been examined. It has been found that the unanticipated innovation in the call money rate by the SBP results in an immediate, but slight increase in the output gap in the same quarter which gets lower than the potential level up to fourth quarter. However, a large reduction in the output gap occurs in the fifth quarter and it continuously remains below the stability path up until the tenth quarter. Since the SBP, like other Central Banks of developing economies, pursue the objectives of growth and price stability in the short run, the theory suggests that with an increase in interest rate there is a decrease in consumption and investment spending. This should lead to a decrease in aggregate demand. Whereas the impulse response apparently shows fluctuations in the first four quarters, one observes that the output gap remains below the long run stability path or the steady state from fifth quarter onwards. This indicates the success of SBP in controlling aggregate demand through contractionary monetary policy action. It may be added that besides private expenditure, an important component of aggregate demand is government spending, especially for economies like Pakistan where fiscal dominance prevails [Choudri and Malik (2012)]. In such a scenario, growth and inflation targets are mostly set by the Government and the role of the SBP reduces to follow this 'dependent policy scenario'.

Panel (b) of Figure 1 confirms that the SBP is successful in lowering inflation in the country with a monetary policy tightening. The results are consistent with the idea of 6-18 months lag in achieving reduction in the demand pressures. Inflation touches the long run stability path after twenty five quarters. Thus, the identification scheme generates no price puzzle. The monetary easing in the subsequent periods has resulted in expansionary effects. The results further indicate that the monetary shock has immediately transmitted positive signals to interest rate which dies out to zero in the seventh quarter.

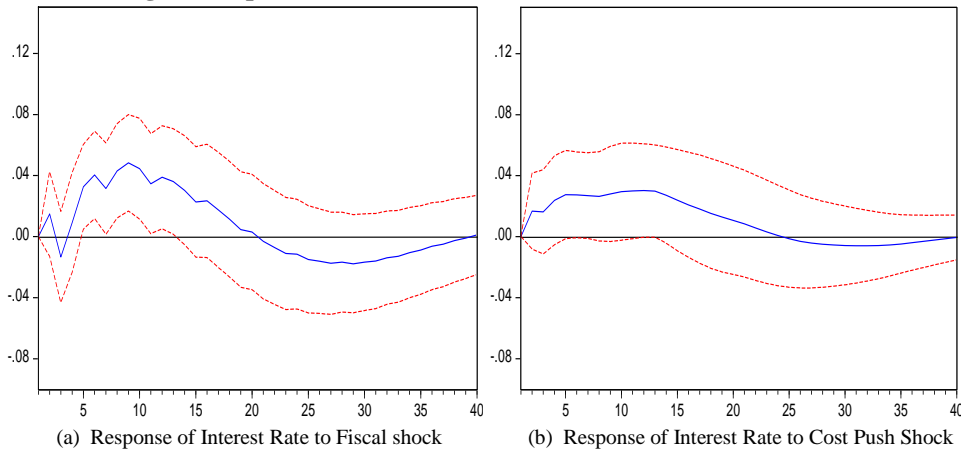**Fig. 1. Macroeconomic Dynamics in Response to a Contractionary Monetary Shock**

(a) Response of Output Gap to Monetary Shock   (b) Response of Inflation to Monetary Shock
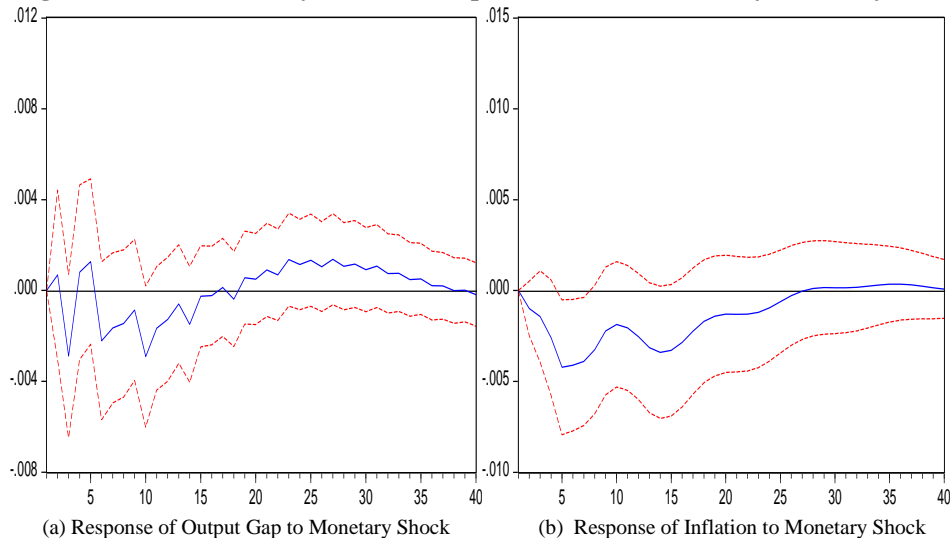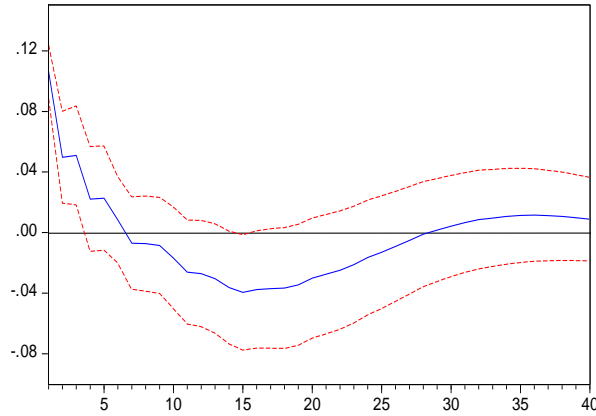
(c) Response of Interest Rate to Monetary Shock

4.2.2. *Assessing Reaction Function*

The focus on the dynamic response of interest rate to fiscal and aggregate supply shocks is expected to allow us to see whether or not the policy reaction function is specified correctly or whether or not the SBP has ever adopted the policy reaction function during the period of investigation. The responses can be traced in Figure 2 below. The results show that in response to a fiscal shock, interest rate increases and takes twenty quarters to get back to its long run path which is facilitated by the expansionary policy in the subsequent periods. In response to positive cost push shock in the country, interest rates started increasing and remained on the higher side up to twenty five quarters.

Fig. 2. Response of Interest Rate to Fiscal and Cost Push Shocks


(a) Response of Interest Rate to Fiscal shock   (b) Response of Interest Rate to Cost Push Shock

4.2.3. *Impact of Fiscal and Aggregate Supply Shocks on Macroeconomic Dynamics*

In response to positive fiscal shock, both output gap and inflation started rising. However, whereas the output gap increases immediately after the fiscal shock hits the economy, the inflation rate started to rise after four quarters.

Fig. 3. Macroeconomic Dynamics in Response to a Fiscal Shock

(a) Response of Output Gap to Fiscal Shock   (b) Response of Inflation to Fiscal Shock
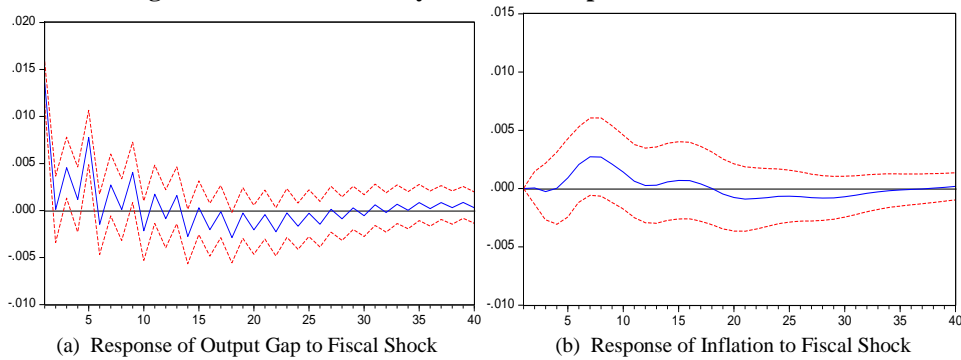
The cost push shock originates from labour market imperfections. Inflation started rising soon after the cost push shock hits the economy but the output gap decreases during the first few quarters but it largely remains close to the long run stability path. This outcome indicates that the cost push shock does not have any significant impact on aggregate demand in the country.

Fig. 4. Macroeconomic Dynamics in Response to an Aggregate Supply Shock

(a) Response of Output Gap to Cost Push Shock   (b) Response of Inflation to Cost Push Shock
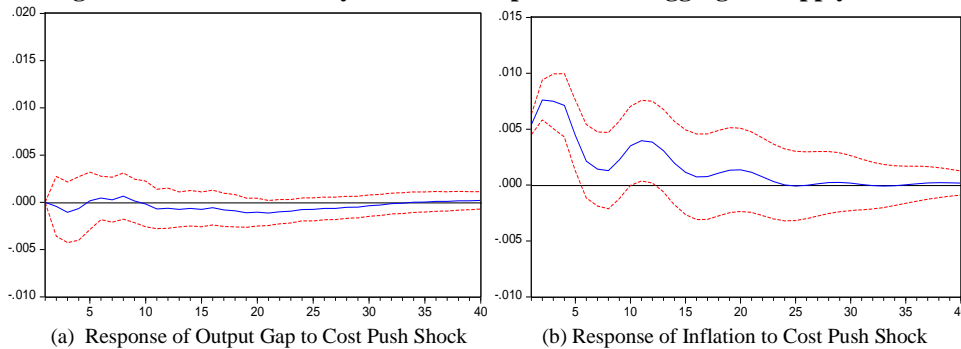
4.3. Variance Decomposition

The relative importance of each structural shock can be examined by studying the variance of forecast error which is decomposed for each structural shock separately.

The top panel of Table 4 depicts the variance of forecast error in the output gap for each structural shock separately for long time horizon. It is evident that the fiscal shock is the major contributor to variations in the output gap which is around 83.6 percent for up to 40 quarters. The monetary policy shock, on the other hand, is the second contributor which remained around 12.84 percent of the forecast error variance. This confirms the significance of fiscal shock in influencing the output gap. The results are in line with the impulse response which shows that even though the SBP is successful in managing the demand pressures, the economy mainly remains demand driven.

The second panel of Table 4 displays the relative importance of the structural shocks in explaining inflation in the country. The results show that supply shock is the main contributor in explaining inflation. From the remaining two shocks, monetary shock

has high power to explain variations in inflation which contribute up to 32.72 percent to variations. Thus the role of the SBP is vital in managing inflation in the country.

Finally, the monetary shock plays the most prominent role in explaining variations in interest rate. The fiscal shock turns out to be the second important determinant of variations in interest rate.

Table 4

Forecast Error Variance Decomposition

	Period	S.E.	Fiscal Shock	Supply Shock	Monetary Shock
Output Gap	1	0.01358	100	0	0
	2	0.01361	99.67213	0.077648	0.250222
	3	0.01462	95.10921	0.810396	4.080392
	4	0.01471	94.70157	0.969436	4.328993
	5	0.01673	95.30892	0.771204	3.919878
	9	0.01778	92.42992	0.819893	6.750182
	13	0.01851	88.63415	1.328436	10.03741
	17	0.01897	87.94153	1.8474	10.21107
	21	0.01944	87.03123	2.850895	10.11788
	25	0.01983	85.54143	3.375936	11.08263
	29	0.02006	84.27488	3.551183	12.17393
	33	0.02017	83.65552	3.547379	12.7971
	37	0.02022	83.59664	3.536292	12.86707
	40	0.02025	83.60757	3.549026	12.8434
Inflation	1	0.00541	0.014161	99.98584	0
	2	0.00933	0.020945	98.87868	1.100378
	3	0.012	0.161422	97.76989	2.068685
	4	0.0141	0.154935	94.98598	4.859086
	5	0.01529	0.241972	88.09243	11.6656
	9	0.01758	5.984871	69.96725	24.04788
	13	0.01955	5.277532	69.05278	25.66969
	17	0.02055	4.887102	63.54804	31.56486
	21	0.02092	5.222687	62.47403	32.30329
	25	0.0211	5.752717	61.51857	32.72871
	29	0.02116	6.25228	61.18585	32.56187
	33	0.02119	6.460753	61.03369	32.50555
	37	0.02121	6.4608	60.97638	32.56282
	40	0.02121	6.469064	60.96894	32.562
Interest Rate	1	0.10628	0.713581	0.500079	98.78634
	2	0.12042	3.020116	3.208405	93.77148
	3	0.13247	2.982892	4.90387	92.11324
	4	0.1371	3.405951	8.020343	88.57371
	5	0.14605	8.479319	11.06629	80.45439
	9	0.17634	27.09277	16.94016	55.96707
	13	0.20522	32.50431	20.0214	47.4743
	17	0.22588	30.14057	19.71455	50.14487
	21	0.23589	27.81507	18.77032	53.41461
	25	0.24047	27.93342	18.10356	53.96301
	29	0.24334	29.28425	17.82769	52.88807
	33	0.2457	30.072	17.67618	52.25182
	37	0.2472	30.02404	17.54731	52.42865
	40	0.24779	29.89015	17.46739	52.64246

5. CONCLUDING OBSERVATIONS

In a path breaking article Lucas (1976) highlighted the inability of macroeconomic models to forecast the consequences of unannounced policy changes. The NK macroeconomic models of recent years possess sundry features, the most consequential being the forward looking expectations modeling approach. The model presented in the present study has been adopted taking into account the NK perspective that incorporates the role of expectations and rigidities.

Rather than relying on 'borrowed' values of parameters, the maximum likelihood estimation procedure through structural VAR model has been used to estimate these values. The parameter estimates confirmed that an increase in real interest rate results in subsequent decrease in output gap which is supported by the theory. The results also demonstrated that forward looking expectations played important role in determining inflation. Output gap helped to lower the inflation rate. The structural parameter estimate of expected inflation rate has shown a negative impact on interest rate. The output gap has an explosive positive impact on interest rate. These results have allowed us to conclude that despite adopting a discretionary stance, the monetary policy has been ineffective, partly because the SBP did not enjoy 'real' autonomy. Since discretionary policy stance generally lacks transparency, it may be useful for the SBP to stick to some sort of rule as has been suggested earlier by Malik and Ahmed (2010). Furthermore, as expectations play prominent role in the prevailing market structure in the country, it is important for the SBP to show commitment towards controlling inflation along with the need for stabilising the demand pressures.

Investigation of the macroeconomic dynamics in response to unanticipated monetary shock has always been an area of interest for the economists that have normally been investigated by analysing impulse response functions. The results have shown that in response to monetary tightening by the authority, aggregate demand displayed a trend consistent with the idea of 6−8 months lag in achieving reduction in the output to its long run stability point. There is no evidence of price puzzle. On the other hand, in response to positive fiscal shock, the monetary authorities raised interest rate to counter the negative effects of fiscal shock to the economy. The results exposed the importance of expectations of economic agents in determining macroeconomic dynamics of the economy which are found to be forward looking. Finally, variance decomposition has emphasised the relevance of fiscal, monetary and cost push shocks as major sources of variation in forecast errors of output gap, inflation and interest rate.

Before closing the discussion, it may be useful to add that there are various methods to estimate DSGE models other than the SVAR model. These alternatives, however, require microeconomic survey based values of parameters which are seldom available. Hence, there has been a 'natural' limitation to rely only on SVAR model. Accordingly, future research in the area of modeling would require that microeconomic surveys are conducted to generate the values of microeconomic parameters. These surveys will also allow the possibility of inclusion of informal sectors of the economy in the modeling approach to have a holistic view of the economy.

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Book Review

Wojciech W. Charemza and Derek F. Deadman. *New Directions in Econometric Practice, General to Specific Modelling, Cointegration and Vector Auto Regression.* Cheltenham, U.K.: Edward Elgar Publishing Limited. 1997. Pages 360. £28.00 (Paperback).

Highly acclaimed and endorsed by leading econometricians, the book "New Directions in Econometric Practice" is not new among the econometrics and statisticians. It is more of a textbook for students of econometrics and statistics at various levels. It impressively attempts to address the main objective of explaining 'how to practice econometrics'. It provides an accessible and user-friendly approach to a new approach and methodology presented by David Hendry in his book, 'Dynamic Econometrics'. The book under review provides a practical and hands-on illustration of Hendry's approach, enabling students to use it for themselves in real world time-series econometric problems. The second edition of the book attempts to address the shortfalls identified by some reviewers in the first edition. By providing practical guidelines in terms of empirical illustration of each technique, using DHSY's suggested aggregated time series consumption function on PC-Gives (8.1 Professional), it opens new trails of research. The book is primarily designed for providing an intuitive understanding of recent developments in econometrics to non-specialist econometricians and is widely adopted by teachers, students and practitioners alike.

The authors of the book articulate Hendry's framework, using unconventional treatments of econometrics in resolving the key problem of empirical econometrics, i.e. matching economic theory with observed data features and developing empirically relevant models. Scrutinising the properties of time series data, this book examines the procedures and tools of contemporaneous econometrics and investigates systematic application of econometric methods to economic data. The contents of the book include a review of traditional methodology, data mining, origins of modern methodology via DHSY consumption function, general to specific modelling, cointegration analysis, vector auto regression, exogeneity and non-nested models, encompassing, and model selection.

The first chapter gives introduction. The second chapter, which deals with the issue of data mining, discusses the experimenter's control over the tools of model selection criteria, namely t-ratios, R-squared, adjusted R-squared, and other goodness of fit criteria. The authors warn that the most commonly anticipated wish to use the fixed data sample in some sequential way may lead to abuse the methodological principles, especially if not applied carefully. The authors realise the fact that some data mining is inevitable, besides they identify the occurrence of Lovell Bias due to the difference between the true and the nominal significance level leading to exaggerated claims of significance.

Chapter 3 reconsiders the original DHSY analysis, with modified and simplified explanations in light of the theory of consumption modelling, aided with computer outputs. This is in recognition for the role this article has played in development of new econometric approach and ideas. The later chapters give a detailed and up-to-date account of these recent developments. In line with Davidson, *et al.* (1978) approach to empirical econometric modelling, Chapter 4 contains a detailed discussion of general-to-specific modelling. The chapter gives the mechanics of general-to-specific modeling by initialising general Autoregressive Distributed Lag Model and gradually reducing it by examining linear or nonlinear restrictions imposed on parameters. It also describes a number of tools for examining these restrictions, for example the Likelihood Ratio, Wald and Lagrange Multiplier tests.

It is noted that the general-to-specific modelling is a method of discovery rather than of confirmation. Although using this technique one may lead to multiple admissible models not nested in each other but the alternative, i.e. the 'bottom up' approach has a major setback in that extending the model may be based upon using erroneous statistical procedures, which may lead, on that one hand, to a plethora of models and excessive data mining, on the other.

The following chapters brilliantly present conceptually difficult but significant ideas from advance econometrics. These ideas and techniques are in focus of the recent advancements and development in the field. Chapter 5 contains detailed discussion on cointegration. The chapter starts with explaining the importance of distinguishing between stochastic trends, with and without drift, and also between deterministic and stochastic trends and seasonality, supplemented by simulation results. It then presents a comprehensive debate on unit root tests and determining the order of integration. Starting with the Dickey-Fuller test, this discussion covers the detailed working of Augmented Dickey Fuller and Integrated Durbin Watson tests. These are aided with recomputed simulations for the Dickey Fuller statistics for larger sample sizes and replications. Dickey Hasza Fuller, HEGY and Dickey Pantula test for seasonal unit root are explained with newly added tables. Special attention is given to Dickey Pantula approach and the Perron's (1989) suggested 'additive outlier' test, covering the treatment for unit root in the presence of structural breaks. Later part of Chapter 5 contains a comprehensive discussion on cointegration comprising of Engle-Granger type test, Cointegrated Durbin Watson (CIDW) and its rule of thumb suggested by Banerjee (1986). Later on, modelling of Cointegrated series through Error Correction Model is explained. Finally, this all is supported by the empirical example of DHSY model.

Chapter 6 studies the traditional and modern approaches for dealing with the relationships described by the system of more than one equation. Under modern approach Vector Autoregressive models (VAR) are presented. VARs are considered as forecasting device for studying causality and cointegration. Within the VAR framework, Johansen's approach and Granger's representation for cointegration are explained. It also contains the impulse response analysis of VARs models and its illustrations. Identifying the problems of VAR models in real world situation, especially when one wishes to handle more than four variables, Chapter 7 sheds light on exogeneity modelling. Concepts of weak exogeneity and strong exogeneity are thoroughly discussed, along with the mathematical descriptions. This chapter also investigates exogeneity properties and invariance properties for the variables in DHSY model.

Problems in choosing between models and the concept of encompassing are the focus of Chapter 8. Cases of nested and non-nested models are identified in relation to encompassing. 'Encompassing' holds when one econometric model can explain the behaviour of relevant characteristics of other models. However, the term 'relevant characteristics' in not possible to be identified in absolute terms, making encompassing a bit complicated and requiring model selection tests. $\bar{R}^2$, Akaike Information Criteria, Schwarz Bayesian Criteria and Final Prediction Error are discussed as model selection criteria. However, these criteria do not aid in deciding which model is better. In addition, J test is discussed for variance encompassing of non-nested models.

Along with worked examples the book contains a large number of working exercises, helping novices in aided learning. The clarity of presenting intuitive accounts of modern advances of econometrics has led this book to be widely adopted in courses of applied econometrics at various levels, which it rightly deserves.

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