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A Modified Approach to Measuring Monetary Policy for Unstable Economies

ABSTRACT

Most of the empirical studies on measuring the effects of monetary policy find positive relationship between interest rate and inflation rate at least in the short run. These studies make use of Vector Autoregressive (VAR) model with small number of variables and then using appropriate identifying restrictions, impulse response functions are estimated. We state, in this paper, that such methodology is inappropriate for unstable economies that are more prone to frequent external and domestic shocks. We hypothesize that positive relationship between interest rate and inflation rate is found due to incomplete capture of endogenous response of monetary policy to changes in inflation rate as variation in the latter is dominated by the effects of shocks. To test this hypothesis, we construct three variables VAR model for Pakistan's economy and data on inflation rate, output and interest rate are taken for the period 2000M01 to 2019M06. We adjust inflation rate for common component of macroeconomic variables, measured as factor score from a group of eight macroeconomic variables; the adjusted inflation rate does not carry information of large shocks that are reflected in almost all of the macroeconomic variables. We find support for our hypothesis as there is negative response of inflation rate to changes in interest rate. This result is robust to different specifications of VAR model and different sets of identifying restrictions to recover structural shocks. Results also reveal that changes in interest rate influence the future path of adjusted inflation rate whereas path of inflation rate – that is correlated with factor score – is pre-dominantly determined by changes in output. Moreover, we find that interest rate Granger causes both components of inflation rate but not the aggregate inflation rate. On the basis of our findings, we support tight stance of monetary policy whenever inflation rate is above acceptable level but cautious response of policy is required in highly and domestically indebted countries and distributional consequences may also be considered before any policy decision.

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Author's contribution in the article: 1- Conceived and designed the analysis, 2- Reviewed and compiled the literature, 3- Collected the data, 4- Contributed data or analysis tools, 5- Performed the analysis, 6- Wrote the paper, 7- Financial support for the conduct of the study, 8-Other

1. INTRODUCTION

For the last three decades, effectiveness of monetary policy has been evaluated using Vector Autoregressive (VAR) Model comprising of policy instrument and the target variables. Short term interest rate is used as an indicator of monetary policy whereas the list of target variables includes unemployment rate, inflation rate, output gap or any other measure of economic activity, bank lending and deposits (see for instance, Bernanke & Blinder, 1992; Sims, 1992). In these models, exogenous policy shocks are separated from endogenous response of policy to state of the economy using appropriate identifying restrictions on structural parameters. Furthermore, this literature has been extended by assuming target variables as latent variables and using underlying factors to measure them. Such Factor Augmented VARs are more informative in that they use more variables without losing degrees of freedom (see for instance, Bernanke et al. 2005; Baumeister et al., 2010; Fernald et al., 2014; Senbet, 2016). Expanded set of variables make researchers able to identify exogenous policy shocks that closely track actual policy changes.

We state in this paper that such VAR or FAVAR models are incapable of tracing the effects of monetary policy shocks on target variables in an economy like Pakistan which is prone to frequent external and domestic shocks and remains unstable most of the times. Whenever economy is hit by a (big) shock, most of the macroeconomic variables change their usual path and their dynamics are then dominated by the effects of that shock. In such a situation most of the energy of policy is consumed to counter the effects of these shocks and the effects of policy cannot be identified. Therefore, researchers are either unable to find significant effect of policy on target variables or they find counter theoretical results. The reason for such finding is that once the momentum of the effects of (big) shocks sets in, then it dominates all other forces that try to lean against the wind, including countercyclical monetary policy.

The objective of this paper is twofold. First objective is to decompose inflation rate into two components; one, that is independent of the effect of big shocks and the other that carries these effects. The second objective is to estimate the effects of monetary policy changes on target variables. We propose a methodology that better suits a country that is more prone to big shocks. To decompose the movement of target variable, inflation rate, into the one dominated by economic shocks and the other that does not carry such effect, we use two steps procedure. In the first step, factor analysis is used to identify common component of macroeconomic variables driven by economic shocks. Factor analysis is a statistical technique used to identify underlying factors or latent variables that explain the correlations among observed variables. There are different methods of factor analysis, such as principal component analysis (PCA) or common factor analysis. In this method, each observed variable is regressed on the extracted factors. The coefficients (loadings) from these regressions represent the relationship between each variable and each factor. Factor score estimates for each individual are then computed by multiplying their observed values on each variable by the corresponding regression coefficients and summing across all variables.

State of the economy is considered latent variable, which is estimated as a factor identified from indicator variables – large scale manufacturing index, inflation rate, interest rate, house price inflation, stock price inflation, exchange rate, money supply, trade deficit, and budget deficit. Whenever a shock hits the economy, most of these variables change their usual path and their movement is dominated by the effect of the shock. This information is captured by factor estimated from above mentioned variables. In the second step, inflation rate is regressed on this factor – common component of macroeconomic variables – and residual is estimated that measures inflation rate, which is independent of the effects of big shocks. This inflation rate is then used in VAR model to evaluate the effectiveness of monetary policy. This newly measured inflation rate is found to decrease after monetary policy tightening; the result is opposite to what is found with aggregate (unadjusted) inflation rate.

Rest of the paper proceeds as follows: section 2 reviews relevant literature; section 3 explains methodology; results are explained in section 4; and section 5 concludes the paper.

2. LITERATURE REVIEW

The literature on identification of monetary policy shocks and measuring the effects of these shocks evolved over time. In 1990s, empirical literature mostly used structural vector autoregressive (SVAR) model to measure monetary policy. Bernanke and Mihov (1998) extended the Bernanke and Blinder (1992) model and they developed semi structural VAR. For identification of monetary policy shocks, they imposed contemporaneous identification restrictions of policy variables to non-policy variables but leave other macroeconomic variables unrestricted. Bernanke et al. (2004) put forward that small number of factors capture valuable information on the basis of large amount of information. Therefore, it is better to use factor-augmented-VAR (FAVAR) model, instead of VAR. They extracted factors by using large amount of information and incorporated in VAR and restriction – monetary policy affects macroeconomic variables with a lag – was used for identification of monetary policy shocks. Furthermore, Uhlig (2005) introduced sign restrictions for identification of monetary policy shocks in VAR methodology. He suggested that monetary policy only respond to prices and non-borrowed reserves. Moreover, the VAR models are also extended by including asset prices in monetary transmission mechanism (Bjornland & Jacobsen, 2013, Yijin & Zeng, 2011; Kserssenfischer & Alessi, 2019). They used two identifying restrictions to identify monetary policy shocks that policy did not affect stock price and output.

The empirical evidence on response of inflation to monetary policy shocks can be categorized into three types. The first type of evidence on response of inflation to monetary policy shocks is consistent with economic theory. In response to monetary tightening inflation tends to decrease, both in short run and long run (see, for instance, Nguyen et al., 2019, Islam et al., 2021, Gern et al., 2023). High interest cost discourages firms' investment demand and consumers' consumption, thereby lowering aggregate demand that results in low inflation rate. In the second category, there are studies that show counter theoretical finding; in response to monetary tightening, inflation starts increasing and this effect does not reverse even in the long run (see, for instance, Vo & Nguyen, 2010; Chowdhury et al., 1995; Barth & Ramey, 2002). When demand for goods is less elastic, then firms do not cut production and investment in response to monetary tightening; rather, they pass on higher borrowing cost to consumers by raising goods prices. In this case, cost channel of monetary policy dominates. The third type includes studies that show positive response of inflation to monetary tightening in the short run while negative response in the long run. Initial positive response of inflation to monetary tightening is known as Price Puzzle that may occur due to forward looking behavior of monetary policy (for evidence on price puzzle, see Bhattacharya, 2013; Salunkhe & Patnaik, 2017; Javid & Munir, 2010; Xiao & Masron, 2017; Al-Mashat & Billmeier, 2007; Estrella, 2015; Olawale & Tarawalie, 2008; Fung, 2002). The hump shaped response of inflation to monetary policy shock reflects dominance of cost channel dominates over the traditional demand channel in the short run but former is dominated by later in the long run.

Empirical literature coped with the counter theoretical finding – positive response of inflation rate to monetary policy tightening – in number of ways. Sims (1992) proposed the solution of price puzzle by including commodity prices because these contain additional information about future inflation (see also, Vinayagathasan, 2013; Kim & Roubini, 2000). Kamada and Sugo (2006) used sign restriction, proposed by Uhlig (2005), that prices do not decrease in response to monetary policy shock; by applying this restriction price puzzle was avoided. Furthermore, problem of price puzzle has been solved by separating permanent shocks reflecting in inflation target and temporary shocks reflecting in interest rate (Bache and Leitemo, 2008). Price puzzle also disappear by including asset prices in SVAR as these prices signal future inflation (See, Bjornland & Jacobsen, 2013; Yijin and Zeng, 2011; Alessi & Kerssenfischer, 2016). Another way of coping with price puzzle is narrative approach. Champagne and Sekkel (2017) identified monetary

policy shock by introducing a new series of interest rate which was extracted from meetings of Federal Open Market Committee (FOMC); this was then used to estimate the effect of interest rate on inflation rate.

However, the empirical literature cited above is criticized based on the fact that VAR models consider only unanticipated changes in monetary policy and ignore systematic response of monetary policy (see, Sims & Zha, 2006; Cochrane, 1998; Bernanke et al., 1997). Moreover, VAR models use only limited information in terms of small number of variables. Price puzzle appears due to this limited amount of information which is less than what is required to forecast inflation. Bernanke et al. (2004) analyze monetary policy effectiveness using FVAR model. They suggest, it is better to augment standard VARs with estimated factors if small number of factors provide useful information on the basis of large amount of information. In this approach, large amount of indicators are used to estimate unobserved latent variables which are responsible for systematic portion of the economy. For instance, series of inflation rate and output are not taken as measured, rather there is large number of variables that are helpful in estimating latent variables – economic activity and inflationary environment (Bernanke & Boivin, 2003). Many studies use FAVAR model and find evidence contrary to price puzzle (see for instance, Beckers, 2020; Hatigan and Morley, 2019; Kaufmann and Lein, 2012; Tulip & Bishop, 2017; Bernanke et al., 2005). For the case of Pakistan, Munir and Qayyum (2013) used FAVAR model consisting of 115 macroeconomic variables; they did not observe price puzzle in their results.

Henzel and Rengel, (2016) highlight that economies evolve overtime and therefore uncertainty does not remain constant. Economies are continuously hit by small economic shocks while they also experience big disasters like great depression, stagflation and global financial crisis. Therefore, paths of economic variables change overtime as they carry information of shocks that hit the economy. As most of the macroeconomic variables are affected by common shocks, therefore, they move together either in the same direction or in opposite direction. Hence, movement in inflation rate – the target variable of monetary policy – is dominated by common component of all variables which carries information of economic shocks. We hypothesize, in this study, that the counter theoretical response of inflation rate to monetary policy shocks is the result of missing information regarding common component, in VAR models that may dominate variation in inflation rate. We therefore, propose to control for common component, measured as factor score, from inflation rate and then to use this adjusted series of inflation rate in VAR model.

3. METHODOLOGY

3.1 Theoretical Framework

In order to estimate the effects of monetary policy on inflation rate and economic activity, we use structural macroeconomic model proposed by Bernanke and Blinder (1992).

$$Y_t = B_0 Y_t + B_1 Y_{t-1} + C_0 P_t + C_1 P_{t-1} + u_t \quad (1)$$

$$P_t = D_0 Y_t + D_1 Y_{t-1} + G_0 P_{t-1} + v_t \quad (2)$$

Y is a vector of (target) macroeconomic variables (output and inflation rate) that depends, in equation 1, on lags of Y and contemporaneous and lagged values of policy variable, P1. The second equation represents monetary policy reaction function, in which, policy variable depends on its own lagged values and current and lagged values of target variables. Equation 1 and 2 represent unrestricted dynamic model with u_t^y and $v^p{}_t$ as independently and identically distributed.

Theoretically, increase in interest rate reduces aggregate demand, which discourages economic activity and therefore decreases inflation rate. Moreover, increase in interest rate signals tight monetary policy stance

[1] The objective of Monetary policy is to smooth interest rate

and makes economic agents expect lower inflation rate in future; inflation rate decreases due to self-fulfilling expectations. However, due to inelastic aggregate demand in the short run increase in interest rate is unable to contain inflation. Producers take increased interest rate as higher cost of production, so they tend to pass on this higher cost of borrowing to consumers; therefore, inflation rate may respond positively to higher interest rate. If this cost channel of monetary policy dominates the demand channel for a longer period of time, then the positive response of inflation rate to monetary policy tightening remains significant in the long run. This result is contrary to dominant view in Monetary Theory; therefore, it can be termed as counter theoretical.

Such result may also be found when movement in inflation rate is dominated by common component of macroeconomic variables that carries information of shocks that hit the economy. When a shock hits the economy then some of the macroeconomic variables change their path and their near future movement is dominated by the effects of this shock. Which of the variables are affected more by a shock depends on nature of the shock; a domestic shock may result in changing domestic demand, while a shock that originates in the external sector of the economy may result in external account imbalances. Inflation rate has the tendency to absorb the effects of all types of shocks if goods prices are not sticky[2]. This tendency of inflation rate makes it positively respond to high interest rate if policy tightening itself is an endogenous response to shock. So, inflation rate must be adjusted for the common component of macroeconomic variables if prices in an economy are not rigid. We propose such an adjusted inflation rate series to be used in VAR model to avoid counter theoretical finding of positive response of inflation rate to changes in interest rate.

3.2 Econometric Methodology

To estimate the effects of short-term interest rate on inflation rate and output, we have used structural VAR model containing three variables:

$$Bx_t = B_0 + \sum C_i x_{t-i} + \varepsilon_t \tag{3}$$

Here, B is a matrix of contemporaneous coefficients, x_t is a vector of endogenous variables, (inflation rate, output and interest rate), C is a matrix of coefficients attached with lagged endogenous variables, and ε contains zero mean, constant variance and serially and contemporaneously uncorrelated structural shocks. The above system of equations can be converted into reduced form VAR as:

$$x_t = A_0 + \sum A_i x_{t-i} + e_t \tag{4}$$

e_t consists of one step ahead forecast errors with zero mean and constant variance. These errors are serially uncorrelated but may be contemporaneously correlated.

3.2.1 Granger Causality

In the first step of analysis, we have used Granger Causality test to check whether or not lagged variables are helpful in predicting other variables.

$$\begin{aligned} y_t &= A_{10} + A_{11}(L)Ly_t + A_{12}(L)Z_t + e_{yt} \\ Z_t &= A_{20} + A_{21}(L)Ly_t + A_{22}(L)LZ_t + e_{zt} \end{aligned} \tag{5}$$

[2] The focus of this study is Pakistan's economy, where prices are found to be more flexible against any type of shock (See, Malik et al., 2008; and Choudhary et al, 2016).

y_t does not Granger cause z_t, which implies that variable y_t is not helpful in the prediction of variable z_t, if coefficients of $A_{21}(L)$ are zero in the above model. We have used F-stats to test this hypothesis of zero coefficients.

3.2.2 Identifying Restrictions

As VAR models are under-identified so some restrictions are needed to be imposed on structural parameters with the minimum requirement that the number of estimated reduced form parameters is equal to that of remaining unrestricted structural parameters that are yet to be recovered. This minimum requirement necessitates restricting n(n-1)/2 number of structural parameters, where n is the number of variables in the VAR model. These restrictions are mostly imposed on S matrix (equation 2), which contains contemporaneous response coefficients.

Our goal is to quantify the impact of interest rate shocks on inflation and output. To do this, we estimate the model in equation 5, then utilize the estimated parameters of these equations to identify structural parameters and recover structural shocks from the system in equation 4 by applying suitable structural parameter constraints.

The moving average representation of VAR in equation 5 is given as:

$$x_t = B(L)e_t \tag{6}$$

$B(L)$ denotes the matrix of coefficients polynomial in the lag operator L, defined as B (L) $=\sum_{j=0}^{\infty} B_j * L^j$. e_t can be written as linear combination of structural shocks as: $e_t = S\epsilon_t$

So VMA can be written in terms of structural shocks as:

$$x_t = B(L)S\epsilon_t \tag{7}$$
$$x_t = \emptyset(L)\epsilon_t \tag{8}$$

Here, $\emptyset(L)$ represents impulse response functions.
Though the forecast errors, e_t, are estimated, the structural shocks, εt, need to be recovered. For that, n(n-1)/2 restrictions are needed on S to identify the system, where n is number of variables in VAR model. In our case, we need three restrictions on structural parameters. We have used two different identification schemes. In the first, interest rate is allowed to respond to inflation rate only after lags, while in the second the former does respond contemporaneously to the later. For instance, in one of the sets of identifying restrictions, economic activity and short term interest rate are assumed to not affect inflation rate contemporaneously. Output is allowed to respond contemporaneously to inflation rate but not to interest rate. Interest rate is assumed to contemporaneously respond to output and inflation rate.

More specifically, Equation 8 with zero restrictions on coefficients can be written as:

$$\begin{pmatrix} \pi_t \\ \Delta y_t \\ i_t \end{pmatrix} = B(L) \begin{pmatrix} S_{11} & 0 & 0 \\ S_{21} & S_{22} & 0 \\ S_{31} & S_{32} & S_{33} \end{pmatrix} \begin{pmatrix} \epsilon^{\pi}{}_t \\ \epsilon^{y}{}_t \\ \epsilon^{MP}{}_t \end{pmatrix} \tag{9}$$

We have estimated VAR model with aggregate inflation rate as well as with two components of inflation rate – one that is correlated with common component of macroeconomic variables and the other that is not.

3.3 Data and Construction of Variables

We define the inflation rate as the percentage change in the consumer price index (CPI), excluding house rent, over the year – twelfth lagged difference divided by twelfth lag and multiplied by 100. In order to

estimate adjusted measure of inflation rate we have generated a common factor by using factor analysis. It is worthy to note that most of the macroeconomic variables change their usual paths in response to big shocks. In this case, monetary policy seems ineffective if effects of shocks are not controlled. Pakistan's economy experienced different crisis, during our sample time period, including huge capital inflow after 9/11 and oil price hike in 2008. All of these shocks significantly affected macroeconomic variables, especially inflation rate. Therefore, we have used budget deficit, trade deficit, asset prices (house prices, stock prices and exchange rate), output, inflation rate and money growth rate (M2) to make a factor score defined as common component of macroeconomic variables. All of these eight variables are indicators of economic crisis and reflect information regarding shocks. This common component dominates variation in inflation rate and monetary policy is found ineffective to control inflation rate if the effect of this common component is not controlled. To find adjusted measure of inflation rate we regress it on the common component found using eight variables and then estimate residual of this regression. This residual series does not contain variation in inflation rate that is dominated by the effects of big shocks.

Output, in our analysis, is proxied by Large Scale Manufacturing Index; this variable is available at monthly frequency and is the most relevant measure of output that monetary policy is supposed to affect. In the VAR model, annualized growth rate[3] of this variable is used. Karachi Interbank Offered Rate (KIBOR) is used for short term interest rate; KIBOR represents money market rate that SBP targets through interest rate corridor system.

We utilized monthly data on output, inflation, and interest rates from 2000M01 to 2019M06. International Financial Statistics (IFS) provides statistics on exchange rates and stock prices. The monthly Bulletin of Statistics released by the SBP contains statistics on CPI, LSM, KIBOR, and M2. The data on the House Rent Index is derived from the Pakistan Bureau of Statistics' Monthly Price Indices. The data on budget deficit is taken from Pakistan Fiscal Operations available on website of Ministry of Finance. Data on trade deficit, defined as imports minus exports, is taken from monthly Bulletin of Statistics published by SBP. Both trade deficit and budget deficit are taken as ratio of GDP.

4. RESULTS AND DISCUSSION

The objective of this paper is to estimate the effects of monetary policy on output and inflation rate. For that, three variables VAR model has been constructed and then impulse response functions are estimated. Forecast error variance is also decomposed into sources of variation in inflation rate. However, in the first step we use Granger Causality test to determine whether or not inflation rate and output are Granger caused by short term interest rate.

4.1 Granger Causality Test

Granger causality test helps determine predictability of a variable in VAR model for other included variables. In our case, inflation rate and output are supposed to carry information on lagged interest rate. After all, if they do not carry then monetary policy does not alter the path of target variables. However, this does not guarantee that the target variables are weakly exogenous as policy may have contemporaneous effects. We have tested Granger Causality for output, interest rate and three measures of inflation rate – aggregate inflation rate, inflation rate adjusted (Appendix A1) for common component, and inflation rate correlated with common component – in separate VAR models. Results in table 1 show that interest rate and output are Granger caused by all measures of inflation. Moreover, both of these variables Granger cause each other in all three VAR models.

[3] Percentage change over the period of one year.

Table 1: Granger Causality among Variables

	Inflation Rate	Adjusted Inflation Rate	Fitted Inflation Rate	Output	Interest Rate
Inflation Rate				47.72 (0.00)	17.35 (0.015)
Adjusted Inflation Rate				58.15 (0.000)	3.76 (0.709)
Fitted Inflation Rate				50.34 (0.000)	20.99 (0.001)
Output	5.56 (0.592)	15.62 (0.016)	30.29 (0.000)		42.41 (0.000)
Interest Rate	10.33 (0.171)	25.31 (0.000)	19.62 (0.002)	14.28 (0.046)	

* Results of interest rate and output in each other's equations are given only for VAR model with aggregate inflation rate. Similar results are found for VAR models with other measures of inflation.

Interestingly, both components of inflation rate – one that is correlated with common component and the other that is not – are Granger caused by interest rate and output. Correlated inflation rate is predicted by interest rate because both of these variables are driven by same shocks, while adjusted inflation rate is predicted by interest rate due to theoretical relationship that exists between these variables. Similar interpretation can be made for predictability by output. However, interest rate and output do not predict future values of aggregate inflation rate. This unusual finding reflects the fact that sign of coefficients attached to lagged values of interest rate and output, in VAR model with correlated inflation rate, are opposite to that found in VAR model with adjusted inflation rate. When aggregate inflation is taken then the coefficients with opposite signs cancel out and the net effect becomes insignificant.

4.2 Impulse Response Functions

Impulse response functions are used to estimate the effects of monetary policy instrument on inflation rate and output. For that we have estimated three variables – interest rate, output, and inflation rate – VAR model. Inflation rate is measured as annualized change in non-house-rent CPI, while output is proxied by annualized growth in large scale manufacturing index. Furthermore, inflation rate is decomposed into two components; one that is correlated with common component of macroeconomic variables and the other that is uncorrelated. Results are given for all the three measures of inflation rate – aggregate rate and the two sub-components. Each measure of inflation rate is used in a separate VAR model. Interest rate is taken in level form; however, analysis is also done with first differenced interest rate. Moreover, as identifying restriction, interest rate is allowed to respond to inflation rate and output only after lags. For robustness analysis we have also assumed contemporaneous response of interest rate to target variables – inflation rate and output. Finally, lag length is selected after testing joint restrictions on coefficients of lagged variables, one at a time, using Likelihood Ratio statistics.

Results in figure 1 show that when interest rate does not contemporaneously respond to inflation rate and output and the former is taken as its sub-component that is uncorrelated with common component of macroeconomic variables, then both inflation rate and output negatively respond to increase in interest rate. This negative effect remains statistically significant for seven months in the case of inflation rate and about two years for output. The negative response is in conformity with the standard economic theory according to which increase in interest rate contracts economic activity, through discouraging investment and consumption, resulting in slowdown of increase in goods prices. The result is also consistent with limited empirical literature that find negative response of inflation rate and output to changes in interest rate. Interestingly, we do not find positive response of inflation rate to monetary policy tightening even in the short run. This is because we have set aside part of inflation rate that is correlated with common component of macroeconomic variables, variation of which is dominated by the effects of big shocks. This pre-dominance of shocks results in finding positive response of inflation rate to increase in interest rate. In this case, discouraging effects of policy tightening, on output and inflation rate, are dominated by the endogenous response of policy to the target variables. When such dominance is controlled and inflation rate

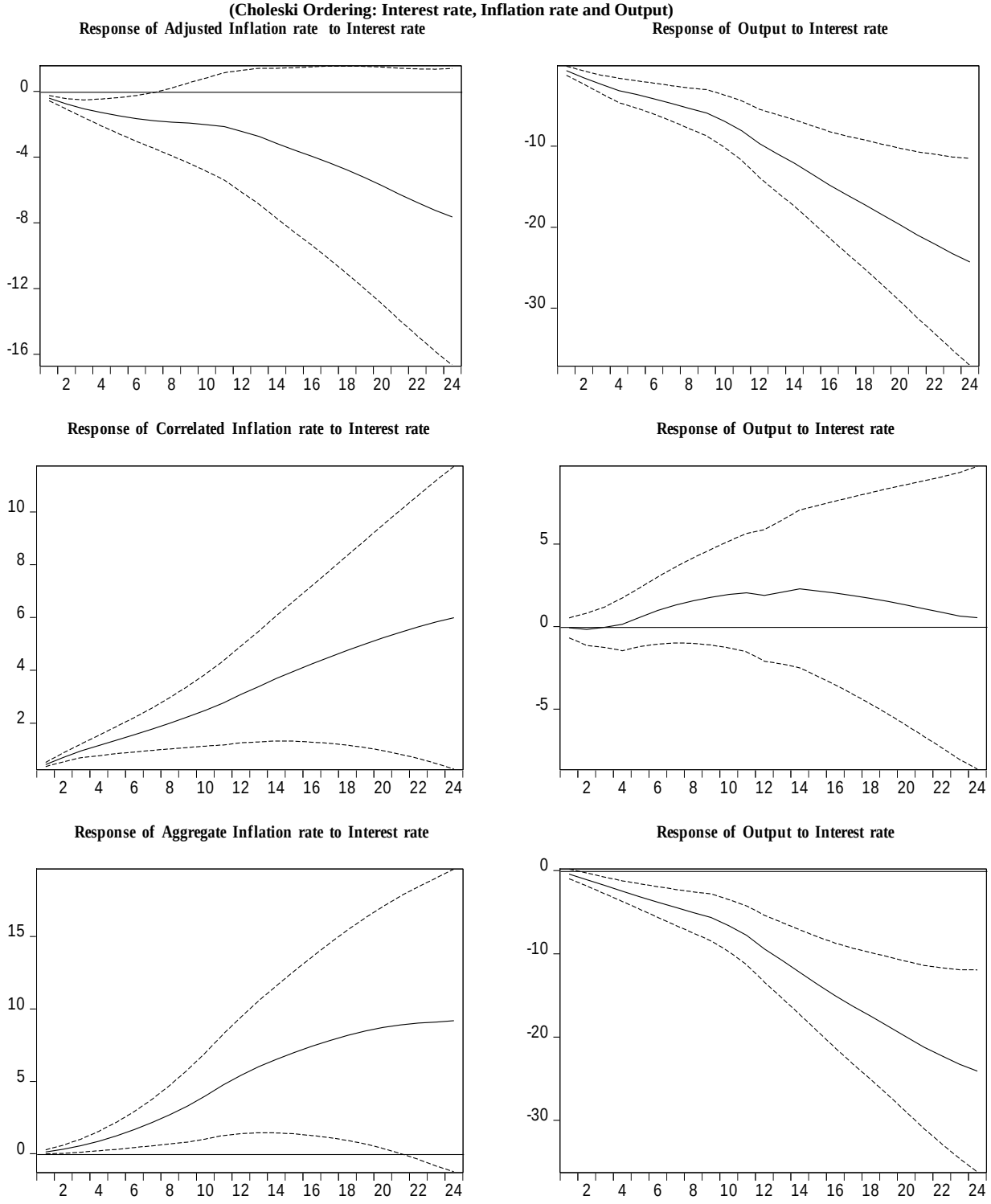
is adjusted for the common component, estimated as factor underlying variation in macroeconomic variables, then actual effects of policy changes on target variables can be estimated. Through such adjustment in inflation rate we are able to avoid counter theoretical result that is there in the empirical literature. It is also important to note that, contrary to existing empirical evidence, we have found less inertia in inflation rate and more in economic activity. This is because the adjusted inflation rate does not carry the persistent effect of shocks that dominate variation in aggregate inflation rate, whereas output is not subjected to such adjustment.

To further support our hypothesis that dominating role of shocks, measured through common component of macroeconomic variables, in variation of inflation rate and the endogenous response of monetary policy to such shocks results in seemingly positive response of inflation rate to interest rate changes, we also estimate impulse response function using component of inflation rate that is correlated with common component of macroeconomic variables. Results in middle panel of Figure 1 show that cumulative response of correlated inflation rate is positive to changes in interest rate while such response is statistically insignificant for output[4]. We also estimated the effect of interest rate on aggregate inflation rate; results in lower panel of Figure 1 show that such effect is also positive – finding that is counter theoretical. This is because positive response of correlated inflation rate to policy tightening is so powerful that it dominates the negative response of adjusted inflation rate. This is not unexpected when monetary policy decisions are predominantly taken as endogenous response to shocks. This result confirms that the seemingly positive response of inflation rate to policy tightening or price puzzle effect can be attributed to endogenous response of policy to changes in inflation rate and the fact that such endogenous response is not fully captured by small number of variables in VAR model. In a country like Pakistan that is more prone to shocks, such endogenous response can be controlled by taking component of inflation rate that is uncorrelated with the effects of these shocks.

[4] Yearly responses are shown in Appendix A2.

Figure 1: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Interest rate, Inflation rate and Output)



Note: Adjusted (correlated) inflation rate refers to component of inflation rate which is (un)correlated with common component of macroeconomic variables. Aggregate inflation rate is sum of these two components.

4.3 Sensitivity Analysis

To check how much sensitive or robust our results are to changing identifying restrictions and model's specification we have redone our analysis number of times. First of all we have re-estimated VAR model with first differenced interest rate but identifying restrictions remain same. Secondly, the variables of VAR model remain same as there in the main analysis but identifying restrictions are changed. When interest rate is taken in first differenced form then all results (Figure 2) are in conformity with that found in the main analysis. Adjusted inflation rate negatively responds to monetary policy tightening; correlated inflation rate responds positively; inflation rate correlated with common component of macroeconomic variables dominates the relationship between inflation and interest rate – response of aggregate inflation rate to interest rate is positive. Economic activity is discouraged by monetary tightening in all the three cases; however, this response is found insignificant when correlated inflation rate is used in VAR model. Similarly, we find same results when different identifying restrictions are used provided interest rate does not contemporaneously respond to inflation rate. More specifically, in one specification, interest rate remains at same position as it was in main analysis but place of output and inflation rate is interchanged in triangular identification. In another specification, we allow interest rate to respond contemporaneously to output while inflation responds to both output and interest rate but output does not respond to other two variables. In both of these sets of identifying restrictions, results remain same as those found in main analysis and in variant of VAR model with first differenced interest rate. These results are shown in Appendix A3 and A4.

We also allow interest rate to contemporaneously respond to inflation rate; in one set of identifying restrictions interest rate contemporaneously responds to both of the target variables while in another it responds to inflation rate within same period and to output only after lags. Results using first of these sets of restrictions are shown in Figure (3) below, while that for second set are given in Appendix A5. In these cases three main differences are noted in results: adjusted inflation rate portrays price puzzle – it first increases in response to policy tightening but then becomes negative in the long run; response of correlated inflation rate to increase in interest rate is found negative; when correlated inflation rate is included in VAR model, response of output to increase in interest rate is found positive. At first glance, these results, especially for that of correlated inflation rate, seem contrary to what has been found in the main analysis. However, both of these results convey the same story. When interest rate is allowed to contemporaneously respond to correlated inflation rate then common component of macroeconomic variables is captured by endogenous response of monetary policy to variation in target variables. Whatever is leftover in interest rate series contains exogenous policy changes, which are negatively correlated with inflation rate. In the main analysis, changes in interest rate were considered as exogenous shocks but inflation rate was adjusted for common component of macroeconomic variables. Hence, when dominating role of shocks, captured through common component, is controlled in any way, relationship between inflation rate and monetary policy instrument is negative. When adjusted inflation rate is considered in VAR model, then price puzzle is found as endogenous response to shocks is not controlled from changes in interest rate.

Figure 2: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Interest rate, Inflation rate and Output)

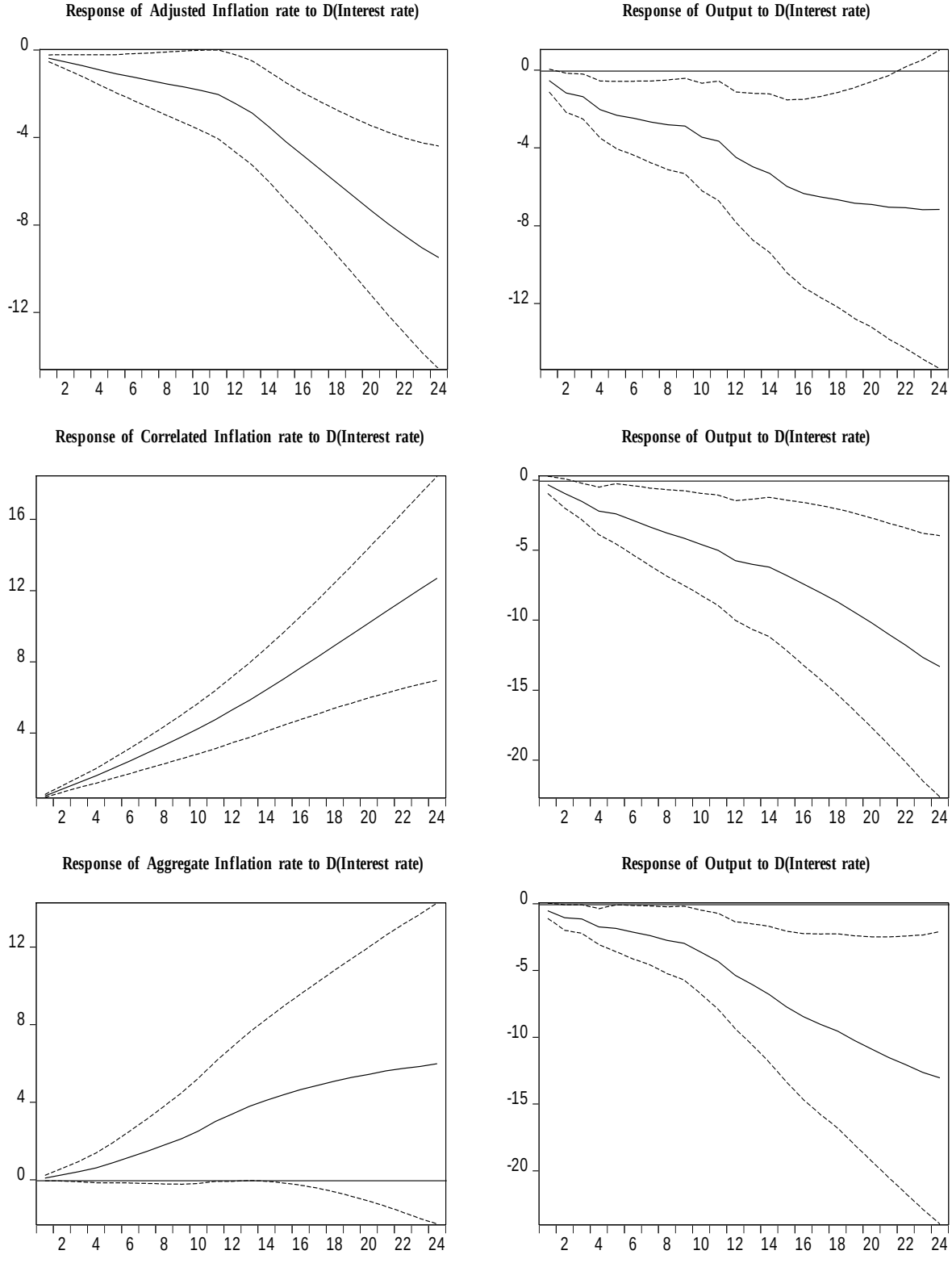
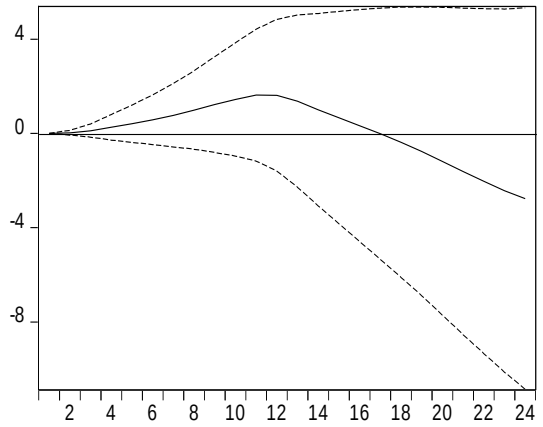


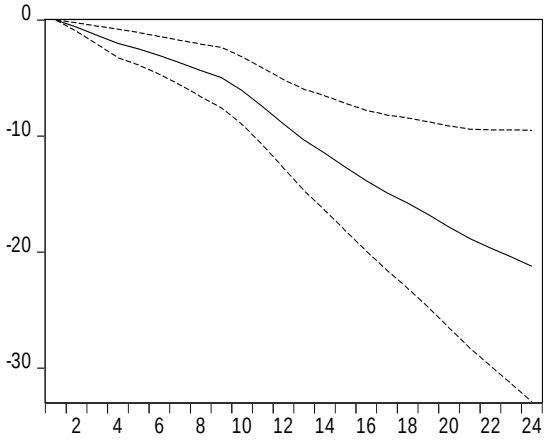
Figure 3: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Inflation rate, Output and interest rate)

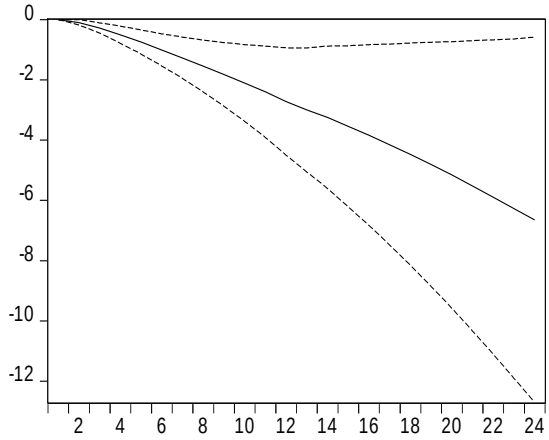
Response of Adjusted Inflation rate to Interest rate



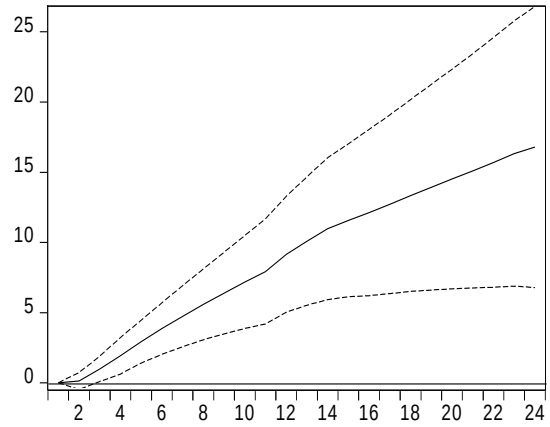
Response of Output to Interest rate



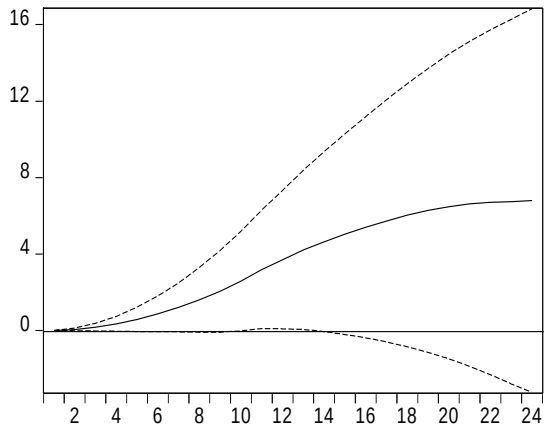
Response of Correlated Inflation rate to Interest rate



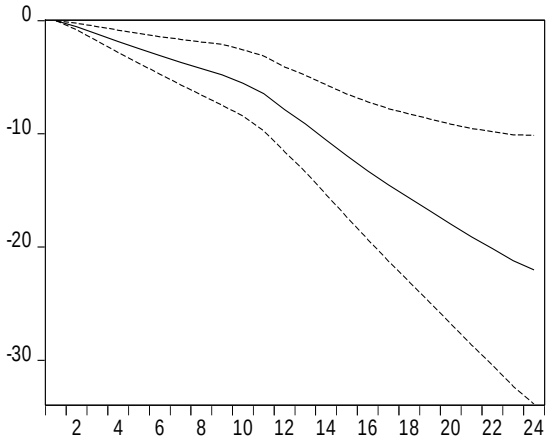
Response of Output to Interest rate



Response of Aggregate Inflation rate to Interest rate



Response of Output to Interest rate



4.4 Variance Decomposition

At the end, we have estimated variance decomposition to know how much variation in different measures of inflation is explained by other variables in the model. The result which is consistent with other studies – variation in inflation rate is pre-dominantly explained by its own lags – is found in case of adjusted inflation and not in case of correlated inflation rate (Table 2). Moreover, correlated inflation rate is much affected by other variables in the model, especially output, which shows that variation in inflation rate is dominated by the effects of shocks. This effect, if not controlled, results in positive response of inflation rate to policy tightening. Finally, monetary policy instrument is more effective for adjusted inflation rate than for correlated inflation over longer period of time. This is because changes in interest rate are unable to affect inflation rate if variation in the later is dominated by shocks in other variables. If that dominant effect is controlled then monetary policy is found effective in determining the variation in inflation rate at longer time horizon.

Table 2: Variance Decomposition of Inflation Rate

	Adjusted Inflation Rate			Correlated Inflation Rate		
Period	Inflation Rate	Output	Interest rate	Inflation rate	Output	Interest rate
1	86.73	0.00	13.27	56.36	0.00	43.64
6	87.38	5.39	7.23	54.58	21.42	24.01
12	86.68	8.03	5.30	47.05	34.42	18.53
18	80.27	7.87	11.86	38.47	44.66	16.88
24	72.75	7.30	19.96	36.28	49.42	14.30

5. CONCLUSION AND POLICY IMPLICATIONS

Most of the empirical studies on measuring the effects of monetary policy find positive relationship between interest rate and inflation rate at least in short run. This literature makes use of VAR model with short term interest rate as policy instrument and inflation rate along with a measure of economic activity as target variables. Interest rate is either assumed to respond contemporaneously to changes in target variables or it is allowed to respond only after lags. We state, in this paper, that such methodology is inappropriate in an unstable economy that is more prone to external and domestic shocks. The hypothesis we set in this paper is that the positive relationship between inflation rate and short term interest rate is because of the shocks that, when hit the economy, influence the path of inflation and if the dominant role of shocks measured through common component of macroeconomic variables is controlled then response of inflation rate to interest rate is not positive. Monetary policy responds to changes in inflation rate but in a VAR model, with small number of variables, that endogenous response is not completely captured and monetary policy shocks are not properly identified; therefore, counter theoretical relationship between monetary policy decisions and inflation rate is found.

To test this hypothesis, we construct three variables VAR model for Pakistan's economy and data on inflation rate, output and interest rate are taken for the period 2000M01 to 2019M06. We adjust inflation rate for common component of macroeconomic variables, measured as *factor score* from a group of eight macroeconomic variables. We find support for our hypothesis as there is negative response of inflation rate to changes in interest rate. However, the usual counter theoretical positive response is found when a component of inflation rate is taken which is correlated with common component of other macroeconomic variables. In previous studies, with positive relationship between interest rate and inflation rate, such effect dominates the theoretical negative relationship. Our results are robust to different specifications of VAR model and different sets of identifying restrictions to recover structural shocks. Results also reveal that changes in interest rate influence the future path of adjusted inflation rate whereas path of correlated inflation rate is pre-dominantly determined by changes in output. Moreover, we find that the absence of

Granger causality from interest rate to inflation rate is due to opposite signs of coefficients of lagged interest rate in the equations of two components of inflation rate; these opposite signed coefficients cancel out and net predicting power of interest rate for inflation rate is found insignificant. This is confirmed by our finding that interest rate Granger causes both components of inflation rate but not the aggregate inflation rate.

On the basis of our findings, we support tight stance of monetary policy whenever inflation rate is above acceptable level. However, this is not an absolute recommendation as our model has certain limitations. Increasing interest rate in a country with high proportion of domestic debt has unintended consequences for debt servicing and fiscal space may shrink to unacceptable levels. Moreover, we suggest to extend this VAR model by including asset prices as controlling inflation rate through higher interest rate, when former is driven by speculation activities in asset markets, may cause income distribution skewed towards asset market and becomes unfavorable for goods market. Moreover, the ultimate goal of monetary policy is to provide enabling environment, through price stability, for sustained economic growth. But as Stiglitz (2012) put it, world as a whole is paying a high price of income inequality in terms of low growth and greater instability. Hence, the ultimate objective of monetary policy is compromised if income/wealth inequality is ignored. Finally, monetary policy cannot ignore inequality in a democratic world; otherwise central banks' autonomy will lose public support. Future work may be extended to differentiate between variation of inflation and output triggered by monetary policy and that caused by other factors. In this case, the true role of asset prices will be estimated by shutting off the response of asset prices to interest rate and variation of output and inflation caused by changes in interest rate.

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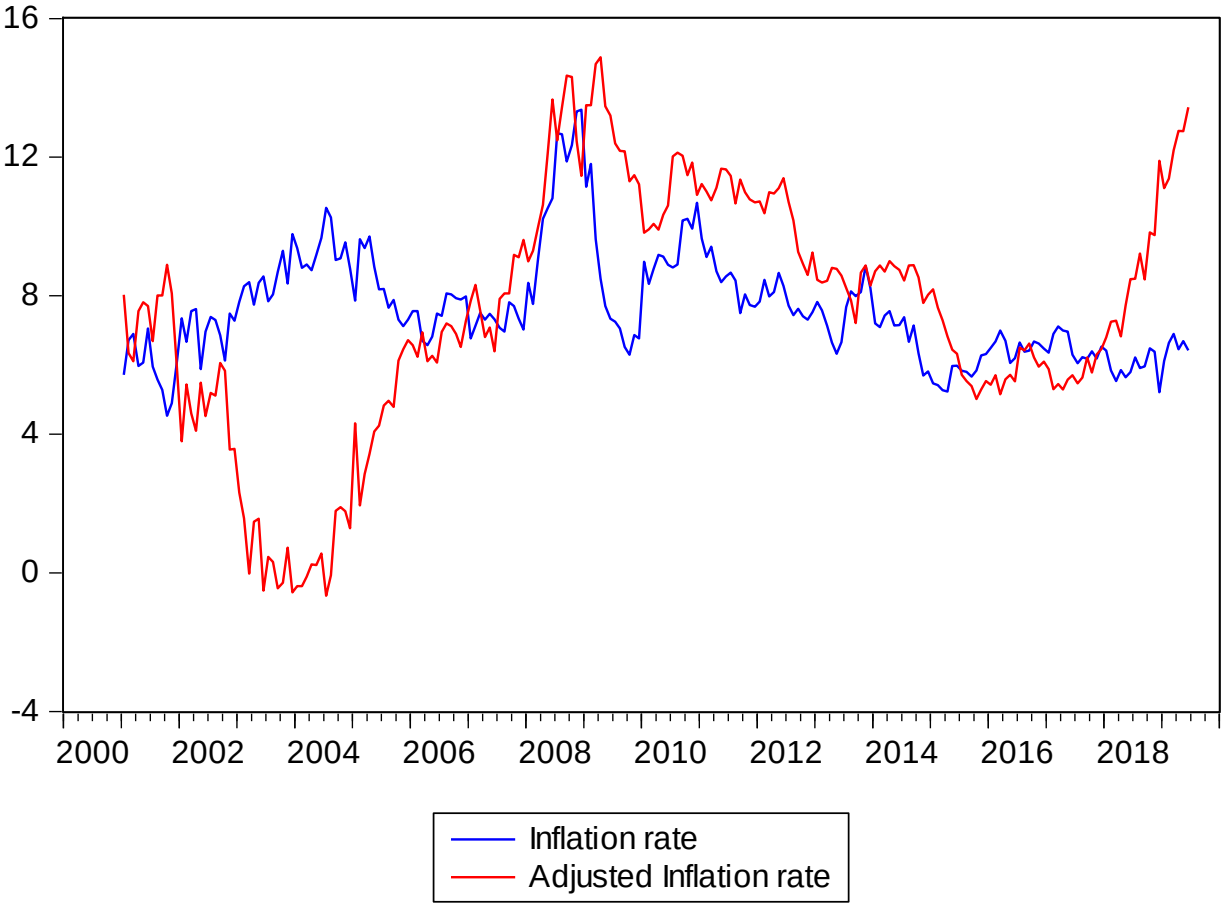
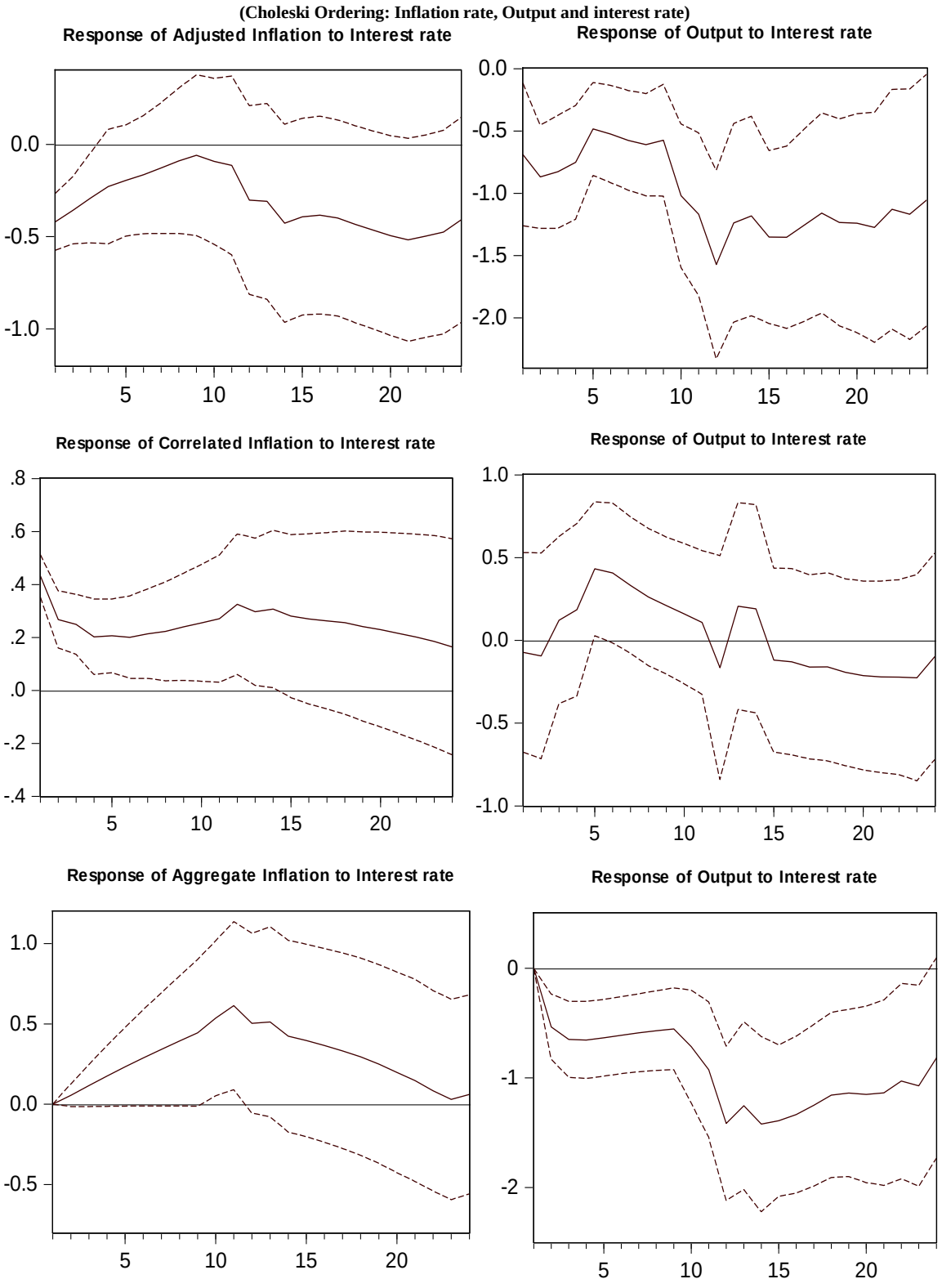
Appendix A1: Inflation Rate and Adjusted inflation rate of Pakistan



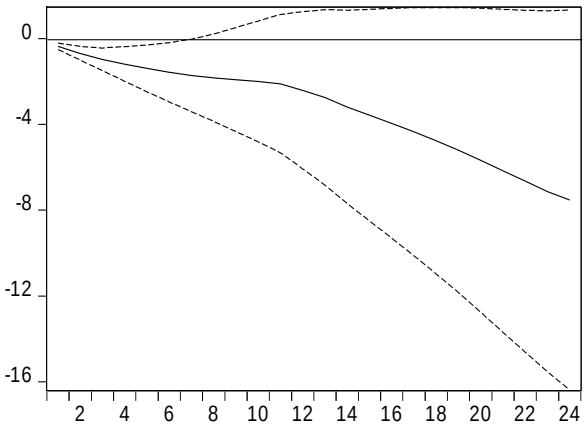
Appendix A2: Impulse Response Functions (± 2 S.E)



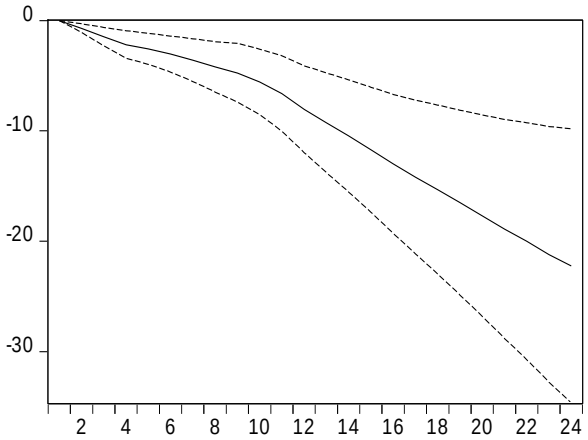
Appendix A3: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Output, Interest rate and Inflation rate)

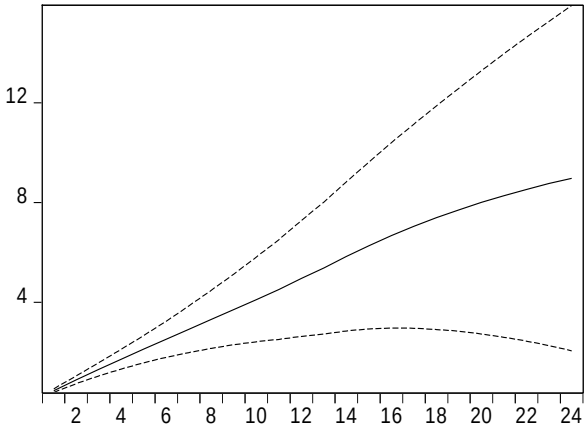
Response of Adjusted Inflation rate to Interest rate



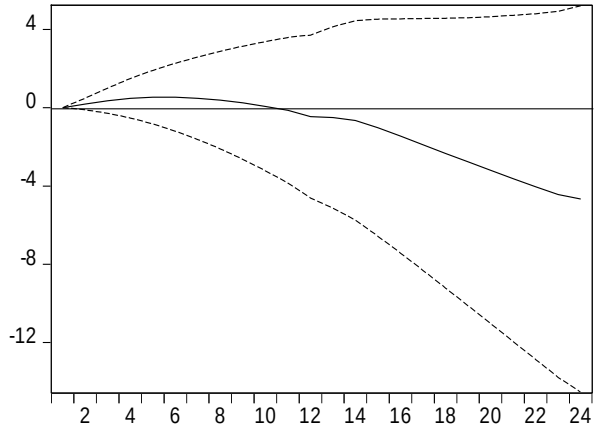
Response of Output to Interest rate



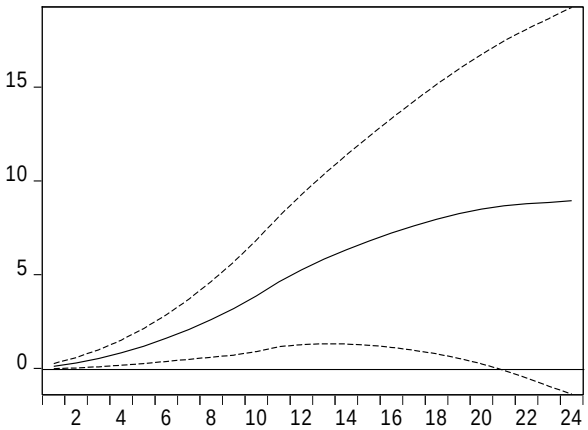
Response of Correlated Inflation rate to Interest rate



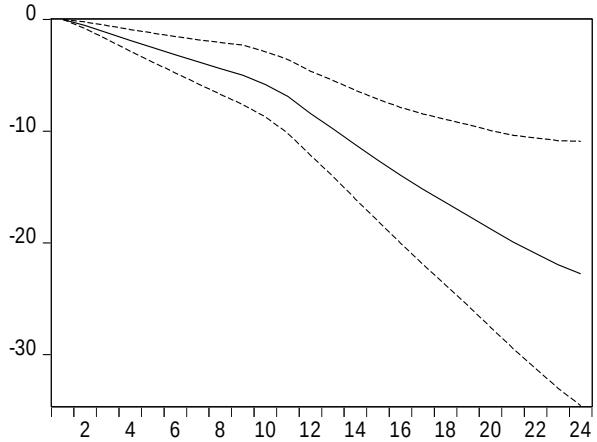
Response of Output to Interest rate



Response of Aggregate Inflation rate to Interest rate



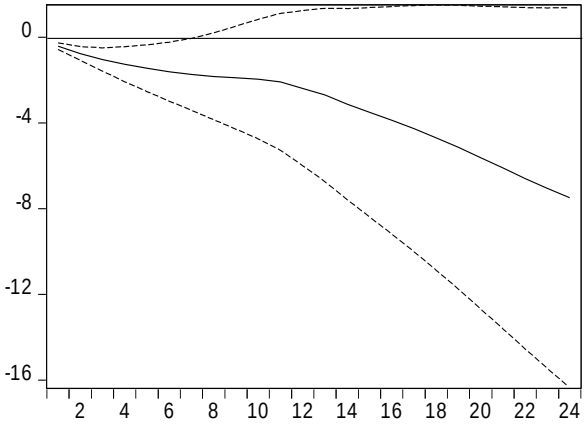
Response of Output to Interest rate



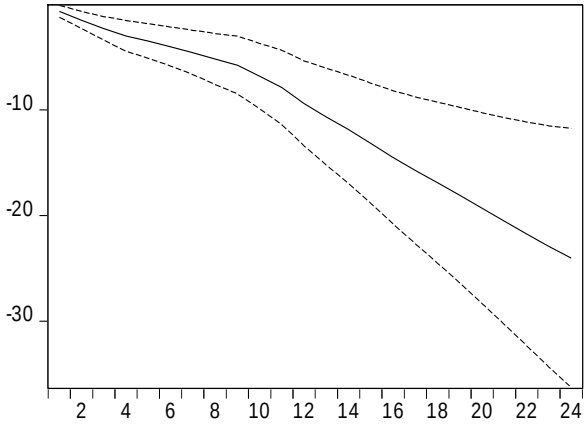
Appendix A4: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Interest rate, Output and Inflation rate)

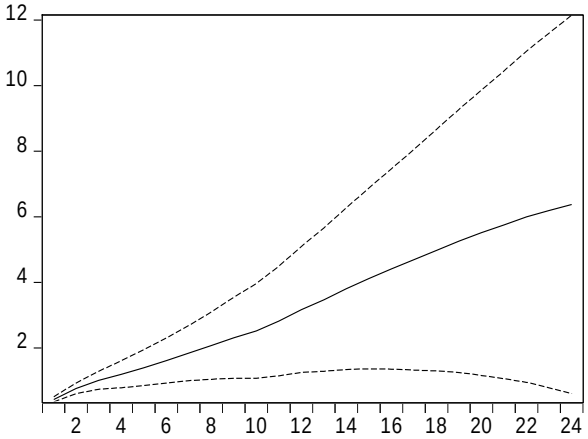
Response of Adjusted Inflation rate to Interest rate



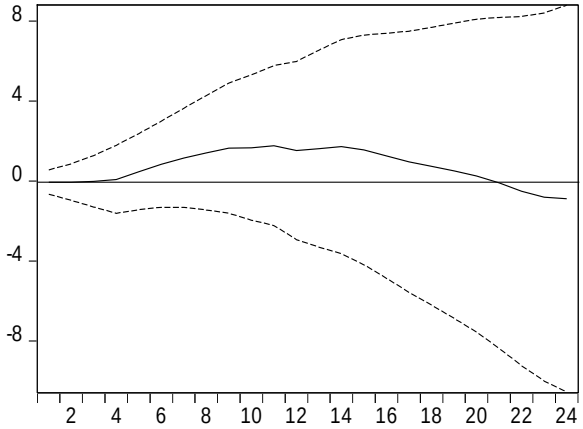
Response of Output to Interest rate



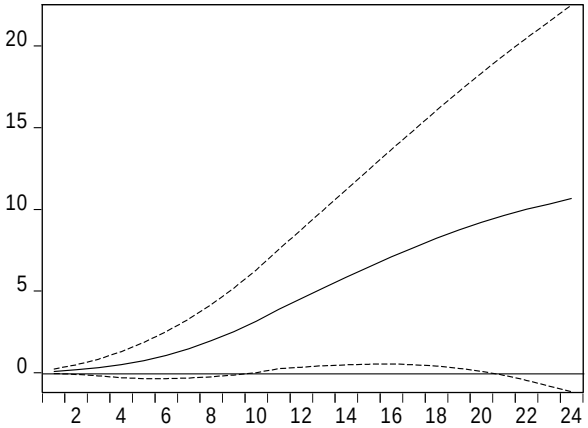
Response of Correlated Inflation rate to Interest rate



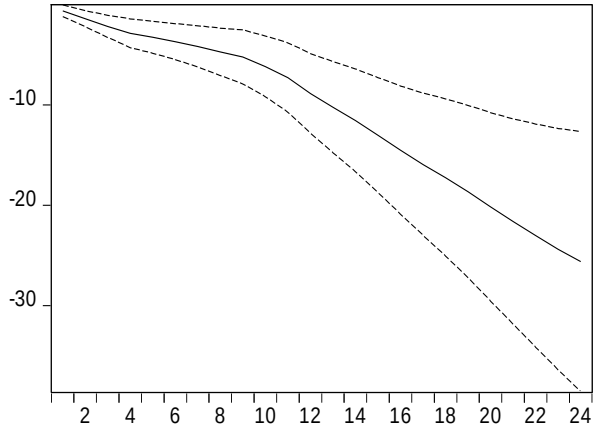
Response of Output to Interest rate



Response of Aggregate Inflation rate to Interest rate



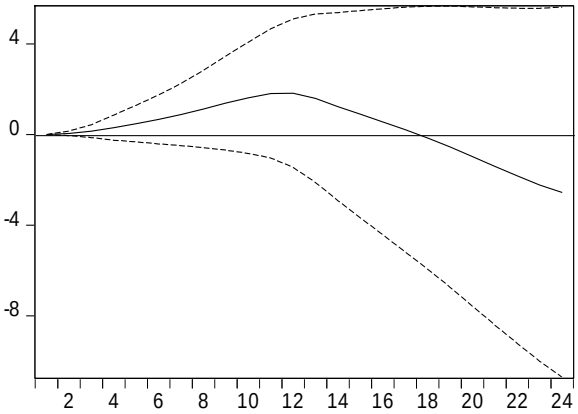
Response of Output to Interest rate



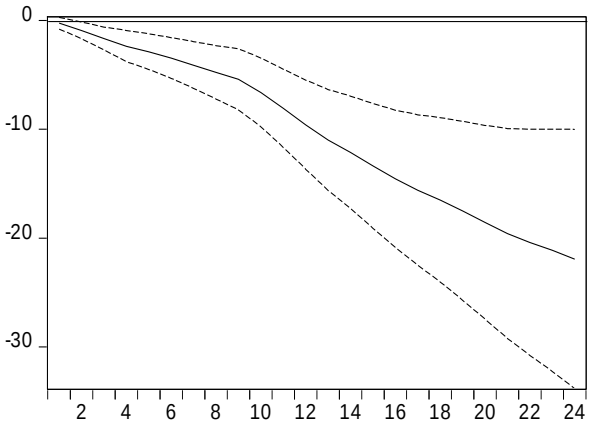
Appendix A5: Accumulated Impulse Response Functions (± 2 S.E)

(Choleski Ordering: Inflation rate, Interest rate and Output)

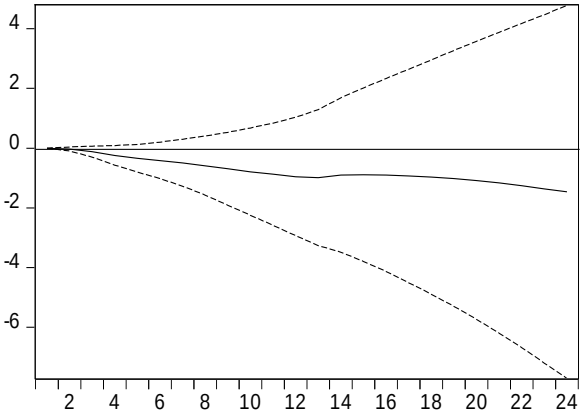
Response of Adjusted Inflation rate to Interest rate



Response of Output to Interest rate



Response of Correlated Inflation rate to Interest rate



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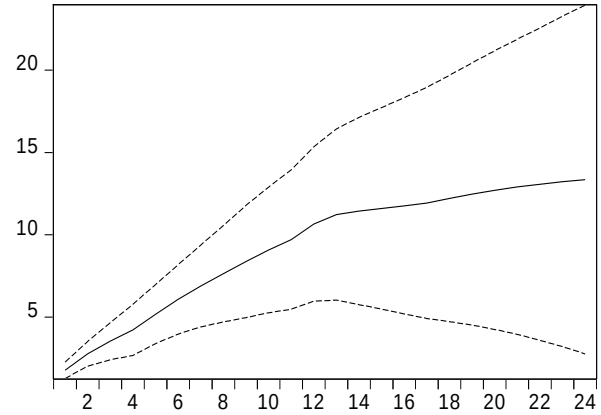

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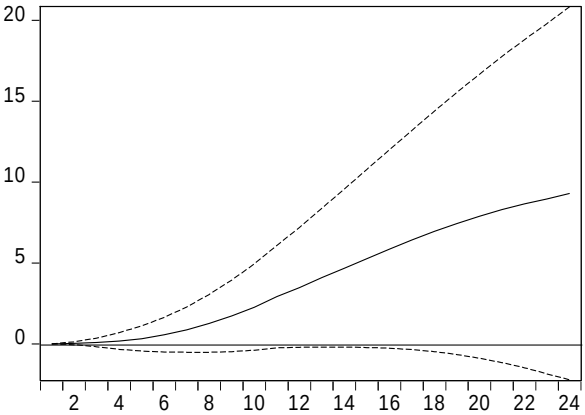

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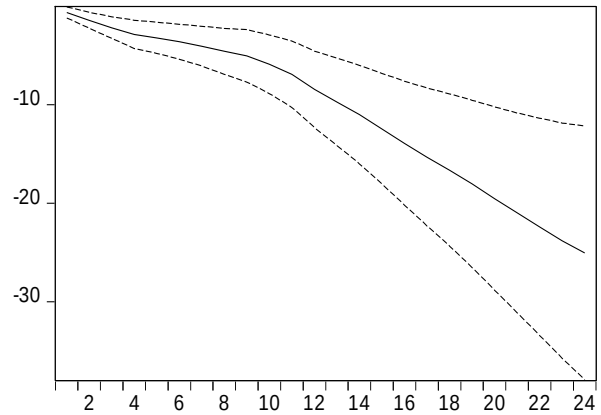

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Harvesting Resilience: Safeguarding Pakistan's Food Future Amidst Climate Challenges

ABSTRACT

As an integral part of Pakistan's agrarian economy, the agricultural sector is vital to the country's overall economic health. The country's strategic position and reliance on natural resources make it extremely susceptible to the negative consequences of climate change. Punjab Province produces over 80% of Pakistan's wheat and has over 90% of its farmers grow wheat. Researchers used to focus on average temperature and rainfall in the study area. However, this study incorporated new variables including CO_2's direct impact on crop growth, average temperature, and urbanization. This study examined how climate change affects Pakistani food security using 1990–2021 time-series data. The primary objective of this study is to shed light on the interconnected nature of climate change and Pakistan's agricultural sector for the benefit of scholars, policymakers, and those with an interest in the subject. To evaluate the long-term and short-term connections between climate change and agricultural productivity, this study uses the Autoregressive Distributed Lag (ARDL) model, which takes into consideration non-stationarity and endogeneity. Data The study's results point to climate change having a major negative effect on Pakistan's agricultural output. According to the extended analysis, the agricultural industry is seeing a continuous decrease because of climate change. The results highlight how critical it is to act quickly to help the agriculture industry adapt to and lessen the impact of climate change. Agricultural initiatives for climate resilience include research on heat-tolerant crop varieties, water management, sustainable farming, renewable energy adoption, carbon pricing, economic diversification, climate-resilient agriculture, improved irrigation systems, trade access, and rural development support.

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Author's contribution in the article: 1- Conceived and designed the analysis, 2- Reviewed and compiled the literature, 3- Collected the data, 4- Contributed data or analysis tools, 5- Performed the analysis, 6- Wrote the paper, 7- Financial support for the conduct of the study, 8-Other

1. INTRODUCTION

Pakistan's agriculture economy is suffering from climate change. Due to precipitation and temperature swings, agriculture is at risk. Climate change hinders Pakistan's agricultural economy. Due to precipitation and temperature swings, agriculture is at risk. Greenhouse gases (GHG) like CO2, CH4, and N2O are a major cause of global climate change (Shakoor et al., 2011). Climate change is projected to cause sea level rise, precipitation pattern changes, and climatic zone shifts due to increased temperatures. Climatic changes will likely worsen droughts, storms, and floods.

Climate change, poverty, and food insecurity are the three main global issues facing humanity today. The reliance on fossil fuels makes no nation secure from the harmful impacts of climate change, and by 2050, 216 million people may be forced to leave their homes due to climate change. Human activities, such as incineration of non-renewable resources, deforestation, and industrial processes, are the primary cause of climate variation, with most of these changes being permanent (World Bank, 2021). Carbon emissions, including carbon dioxide (CO2), are the primary contributor to climate change, causing significant changes in global temperatures and weather patterns. In 2017, global carbon dioxide emissions reached an unprecedented level of 36.2 gigatons (Le Quéré et al., 2018). These emissions have adverse impacts, such as rising sea levels, increased frequency of extreme weather events, and changes to ecosystems and biodiversity. Figure 1 shows that 76% of greenhouse gases are carbon dioxide, 16% are methane, 6% are nitrous oxide, and 2% are HCF, PCF, and SF6 (EPA, 2017).

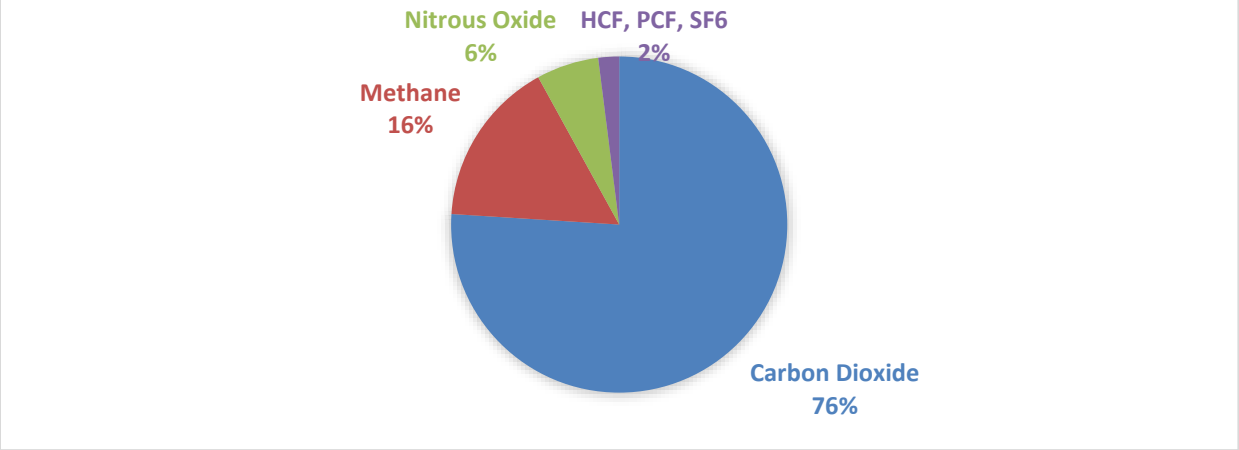

Figure 1: Global GHG emissions by gases.
Source: EPA (2017)

Various studies suggest reducing carbon emissions is essential to combat climate change, requiring switching to low-carbon energy sources, adopting sustainable land use practices, and implementing efficient policies and international agreements (Knutti et al., 2016). Atmospheric carbon dioxide is the major component of greenhouse gases, accounting for 76% of greenhouse gases. The global concentration of carbon dioxide has doubled since the 1700s, reaching 417 ppm (Met Office, 2021). This increase is almost double the pre-industrial era, taking over 200 years for CO2 emissions to increase by 25% by 1986, 40% by 2011, and 50% in just 10 years UNICEF, 2021). This situation is like Pakistan's CO_2 emissions situation, with increased flood frequency and heatwave incidents. Despite disaster management authorities, Pakistan has struggled to mitigate the effects of catastrophes, leading to food insecurity and a global crisis affecting around a billion children (Shahzad & Amjad, 2022).

Pakistan is facing significant challenges due to its geographical location and socio-economic conditions, which have led to significant changes in temperature, precipitation regimes, and severe weather phenomena.

These changes have resulted in increased heat events, droughts, and flooding, affecting agricultural infrastructure, crop loss, soil degradation, and irrigation mechanisms. The rising temperatures and changing precipitation patterns also pose significant threats to water resources, particularly the Himalayan glaciers. The agricultural industry, a crucial sector for Pakistan's GDP, has been significantly impacted by climate change, leading to diminished agricultural output and disrupted food production infrastructures (Haque et al., 2019). Heat stress, water scarcity, and increased pests and diseases have exacerbated the issue of food insecurity, exposing vulnerable demographics to insufficient well-being and nourishment (Akhtar et al., 2020).

The South Asian region, including Pakistan, has experienced a rise in both the frequency and intensity of extreme weather phenomena, posing a significant risk to food and water resources. The Intergovernmental Panel on Climate Change warns that the frequency of extreme weather events is expected to rise in the future, posing a substantial risk to Pakistan's food security (Mendelsohn et al., 2020). Pakistan's food production capacity is directly threatened by climate change, with the Himalayan glaciers experiencing a greater loss in mass since 2000 than they did over the 20th century. This poses a significant threat not only to agricultural activities and income sources but also amplifies the likelihood of water scarcity (Chaudary et al., 2009).

The highly productive regions of Punjab and Sindh are subjected to flash floods, property damage, and loss of life during the summer season due to heightened monsoon rains (Malik, 2022). The conflict in Ukraine has disrupted wheat exports from "Europe's breadbasket," causing damage to approximately 10-15% of their crops. The agricultural productivity of Pakistan may face impediments due to recurrent instances of severe climatic events, making it particularly vulnerable to climate change effects (Global Hunger Index, 2022; Mustafa, 2022).

Pakistan's reliance on natural resources and agricultural sector makes it vulnerable to climate change's adverse impacts on food production, availability, and accessibility. Climate change causes temperature alterations, rainfall patterns, and CO_2 emissions, affecting water availability, productivity, and agricultural yield. Severe weather events, such as cyclones and heat waves, also impact food security by affecting crop, livestock, and infrastructure. Marginalized communities and small-scale farmers are particularly affected due to limited resources and poverty. A comprehensive approach is needed to address these challenges, including implementing adaptable agricultural techniques, improving water management, promoting sustainable land use, and offering diverse livelihood opportunities. Urgent action is needed to mitigate climate change, enhance adaptive capabilities, and ensure sustenance for current and future generations in Pakistan.

Research Questions explored in this study regarding climate change impact on Pakistan's Agriculture:

- Examining short and long-term impacts of climate change on agricultural productivity and crops.
- Investigating socio-economic determinants affecting susceptibility to climate change impacts.
- Identifying vulnerabilities and risks to food security from CO_2 emissions, changing rainfall patterns, and temperature variations.

Climate change mitigation, adaptation, and sustenance for current and future generations are urgent in Pakistan. This study intends to further investigate the short run and long run correlation between climate change variables, namely temperature, and precipitation, CO_2 omissions and the overall agricultural production in Pakistan over both the short and long term. This article is structured as follows: Section 2 presents a review of the literature. Section 3 discusses Data and Descriptive. The econometric methodology is presented in Section 4. Section 5 analyzes Empirical results. Section 6 discusses results. Section 7 presents the Conclusion.

2. LITERATURE REVIEW

Climate change affects vital crop cultivation, affecting food security and agricultural productivity, particularly wheat production, according to numerous studies. Climate fluctuation affects food production, compromising long-term agricultural viability (Wheeler & Braun, 2013). Cold temperatures during wheat flowering are essential. Climate experts agree on two points: Due to rapid global climate change, heatwaves, floods, and droughts have increased by 0.8°C since the early 1900s. Warming might reach 2.4-6.4°C by the end of the century without carbon mitigation. Droughts and floods destroy agricultural production. Due to rising sea levels, arable land is scarcer (Gornal et al., 2010).

By 2080, food demand might rise 300%, but without climate change, supply may fall behind (Cline, 2008). Developing countries that depend on agriculture to reduce poverty are susceptible. The 2007-2008 food crisis showed this susceptibility, exacerbated by climate change (Bandara & Cai, 2014). South Asian countries, despite low greenhouse gas emissions, are hardest hit. Agriculture is affected by harsh weather and warming (World Bank, 2013). Climate change threatens Pakistani wheat, rice, cotton, sugarcane, and maize. Shifting precipitation patterns threaten rain-fed agricultural, which supports 60% of Pakistan's population (Syed et al., 2022). Global warming from greenhouse gas emissions makes Pakistan 12th most vulnerable to climate change (Awan & Yaseen, 2017).

Effective climate adaption is essential. Water management requires irrigation channel modifications. Major emitter livestock production needs sustainable greenhouse gas reduction practices (Baigal, 2016). Climate change increases food insecurity, disproportionately harming vulnerable groups. Yield and water availability affect food supply and diet. Climate-sensitive livelihoods are threatened, and water quality issues can worsen health (WFP, 2015). Climate change affects water supplies, agriculture, biodiversity, and human health worldwide, especially in poor countries (Barnett et al., 2014). Due to its mild climate and agricultural dependency, Pakistan is vulnerable to climate change-induced floods and droughts (Boone, 2008). In Pakistan, spate irrigation is popular in the agricultural industry, which employs 45% of the workforce and contributes 21% to GDP (Câmpeanu & Fazey, 2014).

Climate change impacts food security by reducing crop output, livestock health, and harsh weather (Mustafa et al., 2021). Main crops like maize, rice, wheat, and soybeans are not growing fast enough globally (Parry et al., 2004). Pakistan's irrigation-dependent agricultural industry faces climate change implications, threatening food security and economic stability (Ali et al., 2021). Droughts and floods increase due to climate change, making resource management, technology, investment, and infrastructure harder (Kiseleva, 2003). Water scarcity in Pakistan's Indus basin challenges farmers' livelihoods and food security as temperatures rise and precipitation patterns change (Sarkar, 2012). Climate change reduces agricultural output, causing economic instability, supply-demand imbalances, and commodity prices (Jayne et al., 2010). Due to labor-intensive technology and limited adaptation resources, developing nations are more vulnerable to climate change (ADB, 2009). Rising temperatures and unpredictable precipitation patterns affect Asian agriculture, especially subsistence farmers in rural and poor areas (Shakoor et al., 2011).

Pakistan's rural population depends on agriculture for income and food. The sector's success is essential for poverty reduction and economic growth. Climate change increases the frequency and severity of droughts, floods, and heatwaves, which reduce crop yields, especially for staples like wheat, rice, and maize (Ahmed, 2020; Hussain, 2020). Climate change reduces water availability, forcing farmers to grow water-efficient crops like sunflower and mung bean (Rehman, 2020). Pakistan's food production and accessibility are threatened by climate change. Food availability and pricing are affected by irregular rainfall, extended droughts, and extreme weather (Pakistan Economic Survey, 2021; FAO, 2023). Warming and shifting precipitation patterns reduce crop and livestock productivity, worsening food poverty (World Bank, 2012). Climate change worsens social inequities, especially for women and marginalized populations (Sage, 2014).

These impacts can be mitigated by encouraging resilient agricultural and urban food production (Ziervogel & Frayne, 2011). Managing climate change's many issues demand comprehensive food security and socioeconomic measures.

Agriculture provides food and money to Pakistan's rural population, reducing poverty and boosting economic growth. Climate change increases droughts, floods, and heatwaves, lowering wheat, rice, and maize yields (Ahmed, 2020; Hussain, 2020). Climate change scarcity forces farmers to use water-efficient crops like sunflower and mungbean (Rehman, 2020). Climate change threatens Pakistan's food security by causing unpredictable rainfall, droughts, and harsh weather (Pakistan Economic Survey, 2021; FAO, 2023). Warming and changing precipitation patterns reduce crop and livestock productivity, worsening food poverty (World Bank, 2012). Climate change worsens socioeconomic inequality, especially for women and marginalised groups (Sage, 2014). Resilient agriculture and urban food production can address these issues (Ziervogel & Frayne, 2011). Food security and socioeconomic policies are needed to address climate change's many effects.

To summarize, climate change poses a threat to agricultural and food security in Pakistan and around the world, necessitating strong strategies to offset its numerous consequences.

3. DATA AND DESCRIPTION

Our study includes variables from whom data is taken from secondary source. The sources for our variables are World Bank, World Development Indicators, and Economic Survey of Pakistan. Below is the table 1 that shows the complete description of data and variables that we have taken in our study.

Table 1: Description of Variables

Abbreviation	Name of variables	Unit	Data Source
PERC	Average precipitation in depth	mm per year	World Bank
CO2	CO2 emissions	metric tons per capita	WDI
AVEGT	Average temperature	Degree Celsius	World bank
TRADE	Trade	% of GDP	WDI
GDP	Gross Domestic Product	constant 2015 US$	WDI
URB	Urbanization	% of pop living in urban areas	WDI
AGRI	Total agriculture production	‘000 Bales	Economic Survey of Pakistan

Table 2 provides descriptive statistics for the study variables. AGRI (total agriculture production) displays dispersion with slight negative skewness and a moderately peaked distribution. CO2 emissions exhibit nearly symmetrical distribution. GDP demonstrates a stable distribution. AVEGT, PERC, TRADE, and URB show varying degrees of left skewness and kurtosis, with PERC deviating from normality.

Table 2: Summary Statistics of Variables

Statistics	AGRI	CO_2	GDP	AVEGT	PERC	TRADE	URB
Mean	5.955	69.480	11.17	20.86	29.68	32.22	32.9
Median	6.045	68.703	11.174	20.82	31.38	32.92	33.1
Maximum	7.06	104	11.533	22.67	39.68	38.5	37.4
Minimum	4.79	41.084	10.74	19.79	2.564	24.70	28.1
Std. Dev.	0.699	15.81	0.229	0.60	7.055	3.72	2.74
Skewness	-0.035	0.203	-0.196	0.373	-1.3	-0.41	-0.11
Kurtosis	1.6737	2.516	1.9642	3.449	6.259	2.21	1.84
Jarque-Bera	3.087	0.697	2.147	1.324	30.82	2.24	2.39
Probability	0.214	0.706	0.342	0.516	0	0.33	0.30
Sum	250.13	2918.19	469.28	876.37	1246.82	1353.42	1382.01
Sum Sq. Dev.	20.057	10243.6	2.165	14.77	2040.87	567.81	307.26

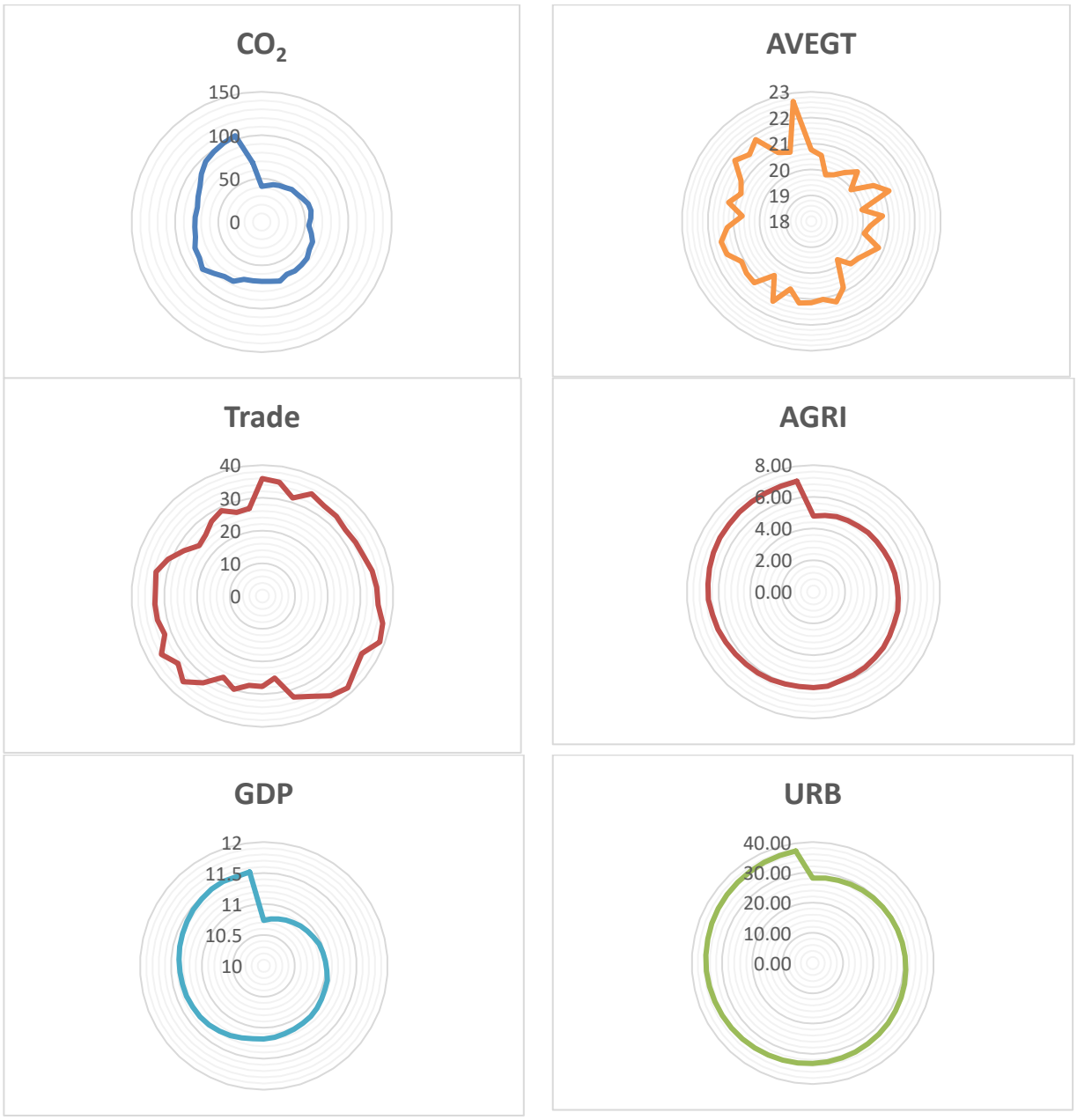

Figure 2: Graphical Illustration of Variables

Figure 2 shows the graphical illustrations of both the dependent and independent variables used in our model using radar chart.

4. METHODOLOGY

Following model has been proposed to determine the impact of CO2, precipitation, average temperature, trade, urbanization, and GDP the total agriculture production in Pakistan.

$$AGRI_t = f(CO2_t, PERC_t, AVEGT_t, TRADE_t, GDP_t, URB_t) \quad (1)$$

We can further specify the above general equation as:

$$AGRI_t = \beta_0 + \beta_1 CO2_t + \beta_2 PERC_t + \beta_3 AVEGT_t + \beta_4 TRADE_t + \beta_5 GDP_t + \beta_6 URB_t + \varepsilon_t \quad (2)$$

In the above equation, AGRI represents the total agriculture production of Pakistan, CO2 represent the total annual CO2 in metric ton per capita, PERC represents precipitation, AVEGT represents average temperature in the given time, TRADE represents trade in the given time frame, GDP represents gross domestic product, and URB stands for urbanization in Pakistan. β_0 is the intercept term in the equation whereas β_5 to β_6 are vectors of parameters. ε_t is the random error term, whereas t stands for the time series that range from year 1980 to 2021.

To construct our equation based on the approach Auto Regressive Distributed Lag (ARDL) which was put forth by (Pesaran et al., 2001), where (-1) with each variable represents the first difference of the variable lagged by one period η0 is the intercept and η1 toη7 are the parameters to be estimated for each variable. εt in the equation stands for the random error term.

$$AGRI_t = \alpha_0 + \sum_{i=1}^{n} \eta_2 \, \Delta CO_{2(t-1)} + \sum_{i=1}^{n} \eta_3 \, \Delta PERC_{(t-1)} + \sum_{i=1}^{n} \eta_4 \, \Delta AVEGT_{t-1} + \sum_{i=1}^{n} \eta_5 \, \Delta TRADE_{t-1} + \sum_{i=1}^{n} \eta_6 \, \Delta GDP_{t-1} + \sum_{i=1}^{n} \eta_7 \, \Delta URB_{t-1} + \varepsilon_t \quad (3)$$

ARDL Co-integration:

$$AGRI_t = \eta_0 + \sum_{i=1}^{q} \eta_2 \, \Delta CO_{2(t-1)} + \sum_{i=1}^{n} \eta_3 \, \Delta PERC_{(t-1)} + \sum_{i=1}^{n} \eta_4 \, \Delta AVEGT_{t-1} + \sum_{i=1}^{n} \eta_5 \, \Delta TRADE_{t-1} + \sum_{i=1}^{n} \eta_6 \, \Delta GDP_{t-1} + \sum_{i=1}^{n} \eta_7 \, \Delta URB_{t-1} + \lambda_2 (CO_2)_t + \lambda_3 PERC_t + \lambda_4 AVEGT_t + \lambda_5 TRADE_t + \lambda_6 GDP_t + \lambda_6 URB_t + \varepsilon_t \quad (4)$$

In equation (4) the term εt represents the error correction term. It captures the short-run adjustment towards the long-run equilibrium. It is noteworthy that the ARDL equation in the long-run encompasses the error correction term, which signifies the pace of adaptation towards the long-run equilibrium.

5. EMPIRICAL RESULTS

5.1 Unit Root Analysis

Table 3 illustrates that although certain variables exhibit stationarity at the level or the first difference, there are others that do not. Employing the Auto Regressive Distributed Lag (ARDL) method, we ascertain the impact of independent factors on the outcome variable in models that comprise both stationary and non-stationary variables.

Table 3: Unit Root Test Results

	ARGI	CO2	GDP	AVEGT	PERC	TRADE	URB
ADF test (at Level)	-0.646	-1.963	-3.1**	-2.99**	-6.4***	-1.999	0.558
Test-Stat (Prob.)	0.848	0.3014	0.036	0.043	0.000	0.286	0.986
ADF test (at first diff)	-6.4***	-2.601	-4.52***	-5.4***	-6.9***	-6.9***	-3.13**
Test-Statistic (Prob.)	0.000	0.101	0.001	0.0001	0.000	0.000	0.032
P-P tests (At Level)	-0.67	-0.67	-0.67	-0.67	-0.67	-0.67	-.67
T-Stat (Prob.)	0.843	0.301	0.067	0.038	0.000	0.290	0.206
P-P test (at 1st difference)	-6.412	-2.595	-4.504	-11.867	-15.12	-6.948	-3.261

5.2 Short- and Long-run ARDL Analysis

Table 4 shows the immediate effects of trade, CO2 emissions, average temperature, precipitation, and urbanization on agricultural productivity. Our services include providing coefficients, t-statistics, standard

errors, and probabilities. Probabilities less than 0.05 show statistical significance. The t-statistics of the significant independent variables (GDP, AVEGT, TRADE, CO_2, PERC, URB) are above 2, indicating a short-term connection to agricultural production. According to significant coefficients, a one percent increase in GDP results in a drop in agricultural production by 1.62539 percent. The agricultural productivity increases by 0.094168 units for every unit of AVEGT. An incremental rise in commerce by one unit leads to a corresponding increase in agricultural output by 0.012097 units. Agricultural production increases by 0.24214% for each 1% increase in urbanization. The presence of CO2 has an indirect negative impact on agricultural productivity, resulting in a decrease of 0.061160 units per unit. Based on the coefficient of precipitation, a one unit increase in precipitation results in a 0.016761 rise in agricultural production. An ECM score of -0.458527 indicates convergence and a 45% convergence will be achieved in a year. Automatic lag length selection criterion is adopted.

Table 4: Short run ARDL outcomes

Variable	Coefficient	Variable	Coefficient
C	10.47***	**D (CO2EMISSIONS (-1))**	-0.021
AGRI (-1) *	-0.46***	**D(GDP)**	0.538
CO2EMISSIONS (-1)	-0.06**	**D (GDP (-1))**	2.06**
GDP (-1)	-1.63***	**D(AVEGT)**	0.005
AVEGT (-1)	0.09***	**D (AVEGT (-1))**	-0.052***
PERC (-1)	0.017***	**D(PERC)**	0.00037
TRADE (-1)	0.013***	**D (PERC (-1))**	-0.013***
URB (-1)	0.24***	**D(TRADE)**	-0.003
D (AGRI (-1))	-0.35***	**D (TRADE (-1))**	-0.008***
D(CO2EMISSIONS)	-0.03**	**D(URB)**	0.571

In Table 5, the probability values, and t-statistics from the ARDL model reveal the long-term relationships between variables. CO2 emissions, GDP and AVEGT are indicating strong long-term associations. However, the probability of precipitation exceeds 0.05, suggesting no significant long-term correlation. Conversely, the probabilities for commerce and urbanization have strong and direct connections with agricultural productivity over time.

GDP, AVEGT, CO2EMISSIONS, PERC, TRADE, and URB exhibit significant long-term relationships with agricultural productivity. Notably, a one percent increase in GDP corresponds to a 3.54481 percent decrease in agricultural production, while a one unit increase in AVEGT leads to a 0.205371 unit rise in agricultural production. Similarly, each incremental increase in commerce boosts agricultural production by 0.026382 units. Conversely, a one percent decrease in urbanization results in a reduction of 0.528971 percent in agricultural production. Additionally, each unit increase in CO2 emissions corresponds to a decrease of -0.045413 units in agricultural production.

Table 5: Long Run ARDL outcomes

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CO_2 EMISSIONS	-0.045***	0.012	-3.931	0.0057
GDP	-3.55***	1.053	-3.366	0.0032
AVEGT	0.21***	0.057	3.633	0.0018
PERC	0.013***	0.001	13.207	0.0000
TRADE	0.027***	0.009	3.01	0.0072
URB	0.53***	0.084	6.325	0.0000
C	22.84***	8.23	2.777	0.0120

Cointegration between variables is predicted by Bound's cointegration analysis. Table 6 shows that bound's test's f-stat value, 7.591514, is greater than both the upper and lower bound critical values at 5% significance.

Table 6: Bound's Cointegration Analysis

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.591514	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.50%	2.55	3.61
		1%	2.88	3.99

The CUSUM and CUSUMSQ diagnostic tests are frequently employed in econometrics to evaluate the temporal stability of parameters in a regression model. Figures 3 and 4 depict the plots of CUSUM and CUSUMQ, respectively. The presented plots indicate that, at a 5% level of significance, the line is situated within the critical values of both the upper and lower bounds. This suggests that the model is stable.

Climate change significantly impacts global agricultural production, including Pakistan's vital agriculture sector, historically reliant on rainfall. Research indicates both favorable and adverse effects of climate change on Pakistan's agriculture. Rising temperatures and erratic precipitation patterns negatively impact agricultural productivity, confirmed by ARDL model analysis. Trade positively influences Pakistan's agriculture, facilitating access to inputs and markets. Urbanization and GDP exert significant effects, altering land use and labor availability. Economic progress often accompanies a shift away from agriculture, affecting productivity.

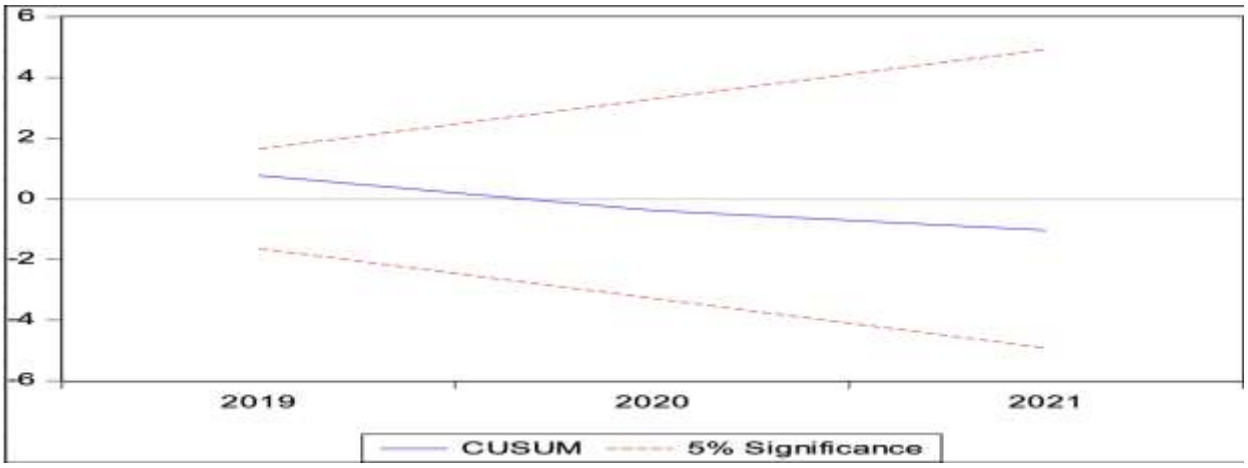

Figure 3: ARDL CUSUM at 5% level of significance.

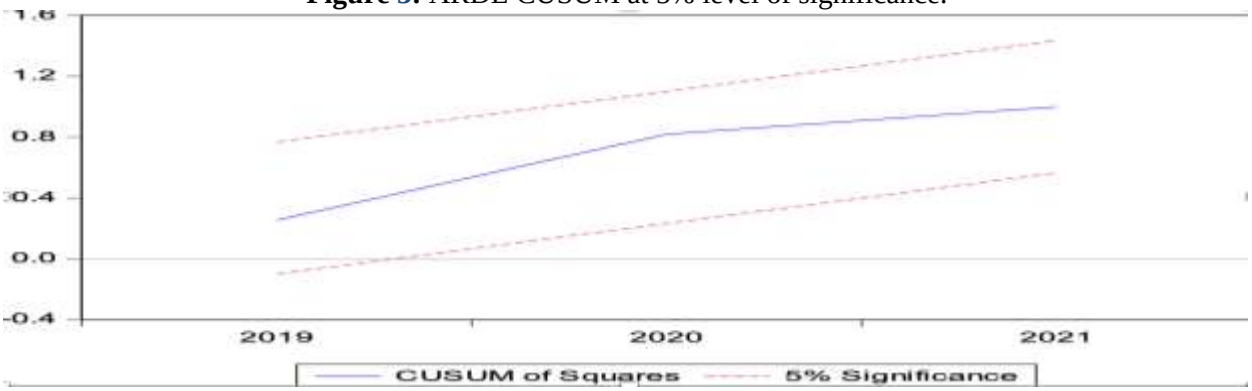

Figure 4: ARDL CUSUM of Squares at 5% level of significance.

CO_2 emissions have mixed effects, potentially enhanced plant growth but also contributing to global warming's adverse impacts on crop production. Pakistan's agriculture is vulnerable to climate-induced water

scarcity, affecting crop yields. Precipitation variability directly affects soil moisture and crop water needs. Insufficient or irregular rainfall leads to droughts, reducing agricultural productivity. Conversely, excessive precipitation causes soil degradation and crop damage. These findings align with previous research, highlighting the critical role of precipitation in Pakistan's agriculture.

6. CONCLUSION AND POLICY IMPLICATIONS

This study examines climate change's impact on Pakistan's agriculture, analyzing significant and insignificant independent variables. Findings reject the null hypothesis and indicate climate change and socioeconomic factors significantly affect Pakistan's food security by influencing total agriculture production. Strong positive correlations exist between total agriculture production, average temperature, precipitation, and urbanization. Conversely, significant negative relationships occur between agriculture production, GDP, and CO_2 emissions.

Climate change adaptation measures are crucial to mitigate rising temperatures' adverse effects on agriculture. Market access, international integration, and urbanization positively affect agriculture. GDP's inverse correlation with agricultural output reflects economic structural transformation during development. While economic growth can redirect resources from agriculture, prudent policymaking can foster sustainable agricultural practices amid economic progress. CO_2 emissions and precipitation play pivotal roles in climate change and water availability, directly or indirectly affecting agricultural results. Policymakers must consider these factors in devising strategies to improve agricultural resilience and sustainability amidst climate change challenges.

To align with the Paris Agreement and sustainable development goals, Pakistan might adopt sustainable policies to:

- Research for heat-tolerant crop varieties and water management systems.
- Implement water management practices and promote drought-tolerant crop varieties.
- Reduce greenhouse gas emissions through sustainable farming and renewable energy adoption.
- Diversify economy from high carbon emissions to sustainable sectors.
- Develop climate-resilient agriculture and improved irrigation systems.

Successful policy implementation requires political commitment, stakeholder collaboration, and financial support. Continuous monitoring and adaptive management are essential for ensuring the effectiveness and durability of climate change adaptation measures for food security in Pakistan.

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Managing External Debt for Economic Growth: Evidence from South Asia Region

ABSTRACT

The burden of foreign debt is a recurrent phenomenon in the fiscal landscape of economies, and it is a key challenge that developing nations frequently face. Every economy uses external debt as a source of finance for capital formation. Previous studies on the relationship between economic growth and external debt lack a nuanced examination of the diverse economic structures and policy frameworks but contribution of current study is focused on the economic structures and policy frameworks, across South Asia Regions. The primary goal of this research is to examine the effect of foreign debt on economic growth. To identify connections between variables, this study utilized a fixed-effect regression model. The predicted variable of this study is economic growth while the predictor variables are external debt, inflation, gross national expenditure, and population growth rate. This study collected data from the world development indicators for the South Asia Region from 1990 to 2019. Ricardo's public debt theory and the debt overhang theory serve as theoretical frameworks for investigating the influence of foreign debt on economic growth. The diagnostic test showed the problem of heteroscedasticity and autocorrelation in the estimated model, therefore, robust estimation is carried out. The government should transparently manage the entire loan phase, including project identification, evaluation permits, and loan negotiations and contracting loan distribution, completion of the project monitoring and assessment, and repayment of loans. The government ought to develop a framework of credible policies to foster an environment that will promote confidence among investors, both domestic and foreign, to make investments in the nation.

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Author's contribution in the article: 1- Conceived and designed the analysis, 2- Reviewed and compiled the literature, 3- Collected the data, 4- Contributed data or analysis tools, 5- Performed the analysis, 6- Wrote the paper, 7- Financial support for the conduct of the study, 8-Other

1. INTRODUCTION

One frequent feature of the fiscal sector of economies is the foreign debt load, which is a well-known problem for emerging nations. Economies typically borrow money from outside sources to stabilize economic growth if the rate of national savings is low. Every economy uses external debt as a source of finance for capital formation. It has been suggested that developing countries with current account deficits are looking to borrow money not only from rich countries but also from the international community to stimulate economic growth. Gohar et al. (2012) suggest that countries may resort to external borrowing due to many factors such as low incomes, budget deficits, and insufficient investment. Furthermore, according to Soludo (2003), countries borrow money mainly for two reasons: either to correct short-term imbalances in the balance of payments or for macroeconomic reasons, to promote economic growth and reduce poverty. External debt is defined by the World Bank (2015) as amounts owed by non-residents that are repaid in foreign currency, products, or services. External debt includes both short-term debt such as commercial debt and International Monetary Fund (IMF) loans and long-term debt such as public and state-guaranteed debt as well as unsecured private debt. The term "economic development" describes an increase in the market value of the goods and services produced by a country or a percentage growth in real GDP.

In general, the terms economic development and growth are often used synonymously. But in reality, economic development means improving a country's overall quality of life, while economic growth often leads to an increase in family income or per capita income. Understanding the dynamics of public debt and its relationship to economic growth is essential. Whether used domestically or abroad, public debt is viewed as a tool for financing government deficits and achieving its social and economic goals. This is especially important when it comes to minimizing the gap between investments and savings.

Due to the accompanying macroeconomic instability, previous debt crises in emerging countries such as South Asia have attracted a lot of attention. The financial structure of any economy is based on a combination of fundamental factors such as low income and productivity, lack of savings, and foreign debt. These factors are essential for the formation of insufficient internal capital in emerging South Asian countries.

Significant effects were caused by incidents like the global financial crisis of 2007–2008 and the European debt crisis of 2008 (Ahmad & Majeed, 2021). Rich economies wind up heavily indebted due to hefty stabilization expenses, and the unnatural rise in public debt during these kinds of crises might obstruct economic growth (Law et al., 2021; Iqbal et al., 2021a, Iqbal et al., 2021b). Furthermore, governments in emerging nations are anticipated to be impacted by the debt crisis and prioritize debt control as industrialized nations become more financially stable.

Rostow (1960) developed an economic development model in research. The paradigm is based on five stages: conventional civilization, takeoff, maturity, preconditions for takeoff, and the era of high mass spending. Rostow's model is considered the most important model for economic growth. The relationship between national debt and economic growth has not yet been elucidated. Economists cannot credibly dispute that using external debt to finance public expenditures is a good, bad, or impartial way to fund investment and conditional growth.

According to the traditional economist, governmental debt depresses investment over time and burdens society. While Ricardian viewpoints view government debt as equal to future taxes, neoclassical economists contend that public debt impedes economic progress (Barrow, 1974). According to Todaro (2012), emerging countries' foreign debt was comparatively modest before the early 1970s. The primary lenders during that time were foreign governments and international financial institutions, who gave loans for a range of development initiatives.

According to Chenery and Strout (1996), the primary objective of foreign debt in developing countries is to close the investment and savings gap. Foreign debt affects investment as well as the expansion of the economy as a whole. Research already in existence suggests that foreign debt has harmed emerging nations' economic trajectories in addition to addressing the savings-investment gap. Donor agency restrictions are mostly to blame for this negative outcome. External Debt Distress in South Asia.

There are many different ethnic groups, languages, and cultures represented in the vast and diversified population of the South Asian region. With developing markets like Bangladesh and India, the area has enormous economic potential. The demographic dividend—a comparatively youthful population—offers a chance for a strong and vibrant labor force that may spur innovation and economic progress. South Asia occupies a critical geopolitical position as the link between the Southeast Asian region, the Near East, and Central Asia. As such, it has significant influence over regional and global international affairs, impacting trade routes, geopolitical behavior, and relationships across borders.

Even though South Asia is one of the world's fastest-growing areas, millions of people there still live in extreme poverty and lack the necessities of a decent life. Impressive growth rates in Bangladesh and India (which have since dramatically dropped) influence regional growth, whereas Pakistan and Sri Lanka saw poor and fluctuating economic development rates. This section examines the impact of foreign debt on gross domestic product to investigate the degree of external debt distress in five chosen South Asian nations.

Figure 1: External Debt of South Asia Region

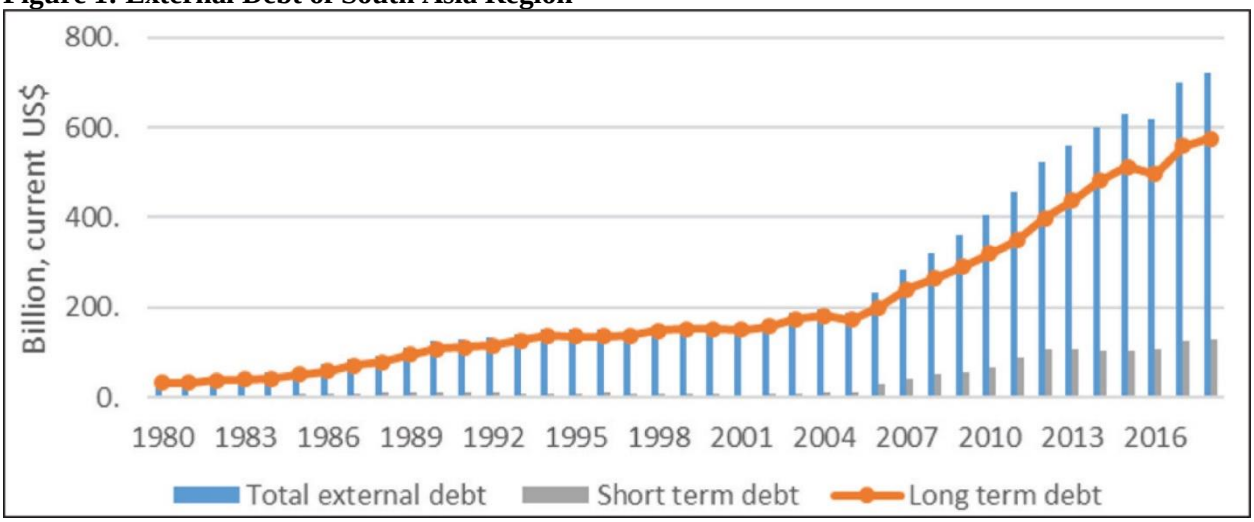

Figure 1 shows that South Asia's total external debt was US$ 36.51 billion in 1980. Over the course of three decades, this debt grew significantly to US$ 722.58 billion in 2018. There are two sorts of external debt: short-term debt and long-term debt. Payables and short-term borrowings account for the majority of short-term debt, which has a maturity date of one year or less. Between 2008 and 2018, there was a remarkable surge in short-term debt, rising from US$ 2.45 billion to US$ 129.94 billion. On the other hand, long-term debt is often taken out for development and has an initial maturity of more than a year. In a few chosen South Asian nations, long-term external debt accounts for the bulk of the total, having grown significantly from US$ 31.52 billion in 1980 to US$ 576.59 billion in 2018.

The main reasons for the growing external debt crisis in some South Asian countries are persistently high current account and fiscal imbalances, as well as limited capital resources being diverted from spending large sums of money on military expenditures and urban infrastructure. This means that the government is wasting money on low-productivity public spending, such as investment. Furthermore, the costs of urbanization increased external borrowing and put pressure on foreign exchange reserves. The literature

describes various methods for calculating external debt and its impact on exports of goods and services and domestic production.

Currently, there is limited research on economic growth and external debt in the South Asia region. More than 50% of the world's population is living in the South Asia region. External debt and economic growth are important macroeconomic indicators. The research gap exists about the macroeconomic determinants of external debt and economic growth. However, there has been limited empirical investigation for policy formulation conducted on external debt and economic growth in South Asia Regions.

There is a noticeable research gap in understanding how specific factors, such as external debt, inflation, population growth, and gross national expenditure are influenced by economic growth in the context of the South Asia Region. Previous studies on the relationship between economic growth and external debt lack a nuanced examination of the diverse economic structures and policy frameworks but contribution of current study is focused on the economic structures and policy frameworks, across South Asia Regions. A nuanced understanding of these interactions will be crucial for formulating effective policy recommendations tailored to the unique economic landscapes of South Asia nations.

The overall objective of the study is to investigate the impact of external debt on economic growth and suggest policy guidelines for the control of external debt.

2. LITERATURE REVIEW

A review of the literature is a significant component of the research process. Because we will be answering new inquiries each time, we must first understand the context of the topic, such as how much work has already been carried out on it, what conclusions have been drawn, and what methodologies were employed in those studies. All of these facts were acquired through the literature. Without knowledge of earlier efforts, one cannot go ahead and declare that their contribution is relevant in a certain sector.

Chaudhary et al. (2000) examined the effect of foreign debt on the growth of the economies of South Asian countries (Bhutan, Bangladesh, India, Nepal, Sri Lanka, Maldives, and Pakistan). According to the analysis, the rate at which these South Asian nations are accruing foreign debt is unsustainable. Additionally, the study showed that foreign debt has a negative impact on economic development.

Kraay and Nehru (2006) have worked with 93 low- and middle-income nations in total. They made use of indicators including real GDP growth, real exchange rate fluctuations, and total debt. According to the findings, many low-income nations currently have high rates of debt distress, and these rates are projected to rise significantly if the massive amounts of development funding needed to accomplish the MDGs are given in the form of historically low-interest loans.

In their research, Jayaraman and Lau (2009) examine the relationship between the Pacific nations' economic development and external debt. The unit root test was carried out by the panel. A Granger causality study was then performed. There is no long-term correlation between external debt and growth, but empirical research indicates that exports, the budget deficit, and foreign debt are additional short-term causal links. A short-term dual causal relationship between economic growth and external debt was discovered.

The analysis by Greenidge et al. (2010) was based on the CARICOM nations' external borrowing. The results of this article also suggest that, given the stated parameters, some of the periods needed to reach this aim are excessively long. However, it is anticipated that this period may be significantly shortened with increased fiscal effort and production growth.

Akram (2011) investigated the impact of debt on Pakistan's economy using data from 1992 to 2006, including statistics on external debt stock, exports, imports, investments, and openness. The study used ARDL, VECM, and ADF unit root tests. The results showed that there is a negative long-term and short-term correlation between Pakistan's per capita GDP and external debt.

The countries studied by Muhanji and Ojha (2011) include Ivory Coast, Ghana, Kenya, Malawi, Nigeria, Senegal, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe. Their study examined many factors such as external debt, imports, inflation, imports for consumption, interest rates, exchange rates, exports, and production. According to the study, both shocks to global interest rates and commodity prices have influenced the rise in external debt in most African countries. In particular, shocks to global commodity prices tend to increase external debt, while shocks to global interest rates tend to reduce accumulated external debt.

Butts et al. (2012) investigated the impact of short-term external debt on economic growth using real GDP growth data and short-term external debt from 1970 to 2003. In this situation, Granger causality analysis, ARDL limit test, ADF and PP unit root test were performed. This result suggests that the impact of economic short-term external debt on consumption exhibits indirect Granger causality. There is evidence that foreign exchange reserves and economic exchange rates influence short-term external debt.

Doğan and Bilgili (2014) investigated the impact of external debt on Turkey's economic development using data from 1974 to 2009. The factors included in this study were an investment, human capital, openness, population growth, GDP growth rate, and the ratio of private and public external debt to GDP. The results show that major growth factors such as investment and human capital have a positive impact on growth. Therefore, growth factors and economic growth were not linear.

Debt and economic development in the Indian economy has been studied by Bal and Rath (2014). The study includes variables such as total factor productivity, exports, debt service, domestic and external debt, and economic growth. The results of the ARDL model in their study suggest that the variables are in a long-run equilibrium relationship. According to the error correction model (ECM), all variables influence short-term economic development, and these results are consistent with expectations.

Siddique et al. (2016) investigated the highly indebted economies of 40 countries. After conducting six different panel unit root tests, we used the ARDL test to examine how external factors affect economic growth. The methodology shows that while debt has fallen since 2000, GDP and goods export growth have increased at their fastest pace since that year. First, the estimation results show that the GDP share of capital creation has a positive impact on the GDP of the HIPC in the long and short term. Second, the debt-to-GDP ratio has negative effects both in the short and long term. Third, merchandise trade has a positive impact on GDP in the long run.

Mousa and Shawawreh (2017) examined how debt affected Jordan's economic expansion. In particular, the study examined the effects of governmental debt, external debt, domestic debt, and debt servicing on GDP. Since the study examines secondary time series data covering fifteen years, a quantitative research technique was adopted (2000-2015). Regression modeling and the least squares method were used to analyze the study's data. The study's conclusions showed that governmental debt in general and external debt in particular had a negative effect on economic growth. These findings led the study team to recommend that countries should lessen their reliance on foreign debt and instead concentrate on making use of their resources.

Vu et al. (2018) examined if there was a threshold impact on the growth-external debt connection using data from ten different nations between 2005 and 2015. According to their research, 33.17% is the ideal level of external debt as a percentage of GDP. Below this level, they discovered a positive correlation

between growth and foreign debt. Beyond this point, though, a 1% rise in external debt results in a 0.02% decline in GDP growth.

Gövdeli (2019) used data from 1970 to 2016 to examine the effects of openness, consumer price index, and foreign debt on economic development. The results of the ARDL method study conducted in Turkey indicate that foreign debt positively affects economic development. Didia and Ayokunle (2020) investigate the impact of external debt and domestic debt on economic growth. A time series analysis was used for this purpose. The period of this study was used from 1980-2016. The dependent variable was economic growth. The explanatory variables were FDI, external effect, domestic debt, and government expenditure. ADF test was used for the unit rest test. OLS method of estimation was used to find out the association between variables. The results indicate that there is a positive association between them.

Mohsin et al. (2021) explore the effects of debt from abroad on economic growth. A nation from South Asia has been selected as an example. This study's predicted variable was economic growth, with predictor factors including external debt, trade liberalization, capital creation, and current account deficits. The panel OLS, fixed effect regression model, quantile regression, and robust estimation were used to determine the association between variables. The findings suggest that foreign debt has a detrimental influence on economic growth.

According to Gnangnon (2021), agency costs between debtors and shareholders minimize the lack of investment and keep reducing firms from adding to equity, resulting in more investment. Shareholders are averse to investing in such businesses (Bruns & Ioannidis, 2020). However, Arvin et al. (2021) argue that high debt levels stimulate economic development. Debt reduces economic growth, whereas external stock increases it (Agyekum et al., 2021; Zhang et al., 2021). A one percentage point rise in total foreign debt results in an additional 36 percent in national production, suggesting an unbalanced link between debt and growth.

Manasseh et.al. (2022) looked at the influence of external debt on economic development. Furthermore, the connections between the effects of leadership, external debt, and external debt volatility were investigated, with a focus on the collaborative impact of governance as measured by Kaufmann (2007) quality governance determines such as government effectiveness, political stability, voice and accountability, regulatory quality, and corruption control on economic growth. The study used yearly time series data from thirty Sub-Saharan African (SSA) nations from 1997 to 2020. The Dynamic System Generalized Method of Moments estimate approach was used to adjust for traditional causes of economic development. The study's empirical findings show that foreign debt and its volatility have a negative and considerable influence on economic growth in sub-Saharan Africa.

Ale et al. (2023) investigated time series regression approaches that were commonly utilized in research that investigates how foreign debt influences economic growth. This paper develops a Time series econometric technique for the period 1980-2020, which is commonly used in studies analyzing how foreign debt influences economic development. This study generates a panel dataset of five South Asian states from 1980 to 2020 and investigates the relationship between external debt and economic development. Pesaran's (2007) Cross-sectionally Augmented Panel Unit Root Test results demonstrate that all variables are integrated in the order I(1). The Cross-Sectional Dependence Autoregressive Distributed Lag (CS-ARDL) approach is used in this study to better comprehend the error-correcting mechanism that governs the short-run dynamic character of foreign debt and economic development. In South Asia, there is a considerable negative relationship between external debt and economic development, both in the short and the long term. Because growing foreign debt is connected with weaker economic development, the study suggests that South Asian countries increase national savings and make investments to reduce their dependency on external debt.

The previous literature study found discrepancies in conclusions about the influence of foreign debt on economic development. Even though some research demonstrates a positive association between external debt and growth, implying that taking on loans can encourage investments and boost business activity, some researchers have discovered adverse effects which include debt overhanging, servicing credit difficulties, and overcrowded out small-scale investment. For many years, economists and policymakers have been interested in the link between external debt and economic development. It has grown critical, especially since the 1980s global debt crisis. The current study varies because of the usage of many countries, approaches, periods, and techniques. Most research investigated the link at the national level, mostly utilizing time series data and methodologies. However, this study utilizes the panel data techniques. The impact of managing debt strategies, such as debt sustainability assessments, restructuring loans, and debt alleviation measures, on the link between foreign debt and economic development is yet undetermined. It is critical to investigate the effectiveness of various managing debt solutions in terms of risk mitigation and improving the economic effect on external loans.

3. ECONOMETRIC METHODOLOGY

3.1 Theoretical background

We briefly discussed some economic theories relating to external debt in the following: -

3.1.1 The Debt Overhang Theory

Krugman (1988) created this idea. According to the hypothesis, there exists a scenario in which the nation's debt surpasses its potential for future repayment. This idea is better suited for underdeveloped nations. This idea states that if the amount of external debt is so high, all income will be used to settle current debt rather than supporting new investments within the debtor nation. The underutilization of resources in the debtor nation or the production gap are often the root causes of such a predicament. Krugman (1988) argues that while relief from debt may benefit both creditor and debtor economies, a higher debt stock modifies the benefits for each. Restructuring the terms of the loan to provide some kind of respite to the indebted country is known as debt relief. This can include taking steps to lessen the burden on the debtor nation, such as lowering the loan's interest rate, principal balance, and loan conditions.

3.1.2 The Ricardo's Theory of Public Debt

Ricardo developed the notion in 1819. The author claims that government spending, whether planned or unplanned, consists of payments made to maintain economic equilibrium even though a sizable fraction of the labor force in the economy is inefficient. Ricardo argued that public expenditure was an inefficient economic activity undertaken by the state in a 1986 letter to McCulloch. After the identification of this fiscal imbalance, Ricardo's theory concentrated on the mounting social cost that results from wasteful state spending. According to Ricardo’s theory of public debt, it may be beneficial to finance public spending by obtaining money from industries and communities that have an abundance of financial resources to lessen inequality. He said that this is because, despite the high levels of taxes and public debt, giving one sector priority over another when allocating public spending has a negative effect on economic growth (Ricardo, 1819). Instead, it makes the state poorer. In a similar vein, the author contended that paying interest on debt impoverishes the state by extorting a sizable portion of society's income to a separate economy. This means that to increase economic growth, governments must take on productive debt, according to Okoye (2013).

3.2 Econometric Optimization

A pooled OLS, fixed effect, and random effect model was used to examine the link between foreign debt and economic growth, inflation, and other control variables (for example, population growth and gross national spending). In our study, multiple observations (T) exceed the number of cross sections (N), resulting in extended panel data. Many scholars employed panel data to investigate the relationship between

external debt and economic development (Muhanji & Ojah, 2011; Chaudhary et al. 2001). On panel data one can estimate the following three models.

- Pooled OLS model
- Fixed effect model
- Random effect model

The econometric model of this study is given below:

$$Y_{it} = \beta_0 + X'_{it}\beta + Z'_{it}\alpha + U_{it} \quad (1)$$

In the above equation, Y_{it} is the economic growth and is the dependent variable of this study, while the x indicates the vector of core variables such as external, and gross national expenditure. The Z indicates the vector of control variables such as the inflation and population growth.

4. RESULTS AND DISCUSSION

Data for each variable were collected from 1990 to 2019. The statistics for macroeconomic variables (i.e. GDP per capita, foreign debt, population growth, and gross national spending) were obtained from World Development Indicators.

A given national currency is used to calculate the annual growth rate of GDP per capita. Divide the GDP by the mid-year populace to get GDP per capita. The total value added by all local manufacturers in the nation, after deducting consumption taxes and excluding funding not involved in the product valuation, is GDP at buyers' prices. This calculation subtracts depreciation of constructed assets and does not take into account exhaustion and deterioration of environmental assets. Studies like Mousa and Shawawreh (2017); Serrao (2016); and Egbetunde (2012) used economic growth as the dependent variable.

One measure of the total amount of external debt is the foreign debt to GNP- ratio. Amounts due to nonresidents that can be paid with money, products, or services are included in the total amount of external debt. This covers the use of IMF finance as well as short-term and long-term debt, which can be provided, guaranteed, or not guaranteed by the government. All commitments having an initial short-term maturity are considered short-term debt, including past-due interest on long-term debt. Goods and Services Tax (GNI), formerly known as GNP, is the total value created by all local producers. Together with net foreign primary income receipts, it includes any product taxes (apart from subsidies) that were not previously factored into the production valuation. These receipts cover both property revenue and employee remuneration. Studies like Serrao (2016); Siddique et al. (2016); Egbetunde (2012) used external debt as the independent variable.

Table 1: Variables and its descriptions

Variables	Symbols	Measurement	Source
Gross Domestic Product	GDPP	Per capita growth annual %	WDI
External Debt	EXT DEBT	% of GNI	WDI
Inflation	INF	Consumer price index	WDI
Population Growth	POP	Annual %	WDI
Gross national expenditure	GNE	% age of GDP	WDI

The middle-of-the-year population expansion exponential rate over period t-1 to period t, expressed as a proportion, produces the yearly increase in the population during period t. Population projections are based on the real description, encompassing all citizens and immigrants. Gross local expenditure (also referred to

as local absorption is the total of household final consumption (which used to be recognized as individual consumption), the public sector is the final consumption (which used to be referred to be overall government consumption), and gross generation of capital (originally referred to be gross local investment).

The yearly percentage variation in the usual consumer's rate for a predetermined consumption bundle is used by the consumer price index. This basket might stay the same or could alter regularly, like once a year. The Laspeyres formula is often used in the computation.

5. RESULTS AND DISCUSSION

This section highlights a study's major findings, interpretations its findings for readers, and discusses their importance. It also includes the findings of diagnostic procedures, such as the Wald test for heteroskedasticity and the Wooldridge test for autocorrelation, as well as the outcomes from robust estimations as an appropriate correction of heteroskedasticity and autocorrelation.

According to the descriptive statistics, Bhutan has the highest percentage of GDP per capita growth (annual %). There are several reasons behind Bhutan's strong GDP per capita growth. The nation's emphasis on Gross National Happiness (GNH), which prioritizes overall well-being over just economic metrics, is one important component. Bhutan's economy is also growing as a result of exporting hydroelectric power, adopting sustainable development methods, and gradually opening up to tourists. Nevertheless, Iran exhibits the lowest GDP per capita growth among selected economies when analyzed in comparison. This can be attributed primarily to geographic conflicts, economic sanctions, and heavy dependence on oil exports, all of which significantly hinder Iran's economic development. The country's GDP per capita growth rate is further affected by political instability and international isolation, collectively impeding overall economic progress.

Outcomes of descriptive statistics revealed that Iran has the lowest external debt as compared to other selected nations. Iran is a major oil exporter, and its oil export earnings have traditionally been a sizable source of cash. The nation has been able to satisfy its financial demands thanks to this cash stream without having to rely as much on borrowing from outside.

Results of descriptive statistics show that Pakistan has the highest inflation rate than other South Asia countries. Pakistan has had difficulties in the energy industry, such as problems with the availability and cost of energy supplies. Price swings in energy, especially for gasoline and electricity, can have a domino impact on the economy as a whole. On the other hand, Sri Lanka has a low inflation rate as compared to other selected economies. Inflation can be contained by the Central Bank of Sri Lanka implementing a stable and well-managed monetary policy. Effective control of interest rates, the money supply, and other monetary instruments may be necessary for this. Sri Lanka's economy is growing steadily without becoming too hot. It lessens the possibility of pressures leading to inflation.

According to descriptive statistics, Iran has the fastest rate of population increase. Larger families have always been supported by pro-natalist policies in Iran. The goal of these strategies was to boost population growth to solve demographic issues and promote economic development. Bangladesh's population growth rate is the lowest because the country has successfully developed family planning programs that give access to contraception and education. The decrease in birth rates has been attributed to these initiatives.

Results of descriptive statistics show that Bhutan has the highest gross national expenditure as compared to other nations. Bhutan is increasing its level of expenditure by investing heavily in development and infrastructure projects. This includes transportation-related initiatives. Healthcare, energy, and education. However, when compared to other economies, Iran's gross national spending is the lowest. Economic

restrictions imposed on Iran may limit its capacity to deploy resources and raise total spending. Sanctions have the potential to restrict access to foreign financial institutions and markets.

Table 2: Descriptive Statistics

Countries	**Variables**	**Mean**	**Standrad Deviatiation**	**Minimum**	**Maximum**
Pakistan	GDPP	1.83826	1.9474	-1.9127	5.4478
	EXT DEBT	38.8898	10.74311	24.39	55.897
	INF	2.3097	0.6379	1.2040	3,2974
	POP	8.40	4.0706	2.5293	20.28612
	GNE	105.25	3.075	100.32	110.5973
Nepal					
	GDPP	3.22	1.977	-1.3663	7.7312
	EXT DEBT	37.3070	15.69	16.5353	60.00
	INF	1.3648	0.8053	0.1859	2.7986
	POP	7.5152	3.5922	2.2692	17.149
	GNE	116.37	6.1330	106.87	126.81
Sri-Lanka					
	GDPP	4.33	2.190	-2.2942	7.818
	EXT DEBT	56.086	9.7416	37.374	73.7268
	INF	0.831	0.2491	0.3788	1.2488
	POP	9.0489	5.0755	2.1350	22.5645
	GNE	107.5297	2.1916	103.64	113.6861
India					
	GDPP	4.50	2.008	-1.045	7.0131
	EXT DEBT	22.1648	4.6128	14.880	33.157
	INF	1.6149	0.3443	1.0253	2.1411
	POP	7.2897	3.220	3.3281	13.870
	GNE	103.36	2.563	97.6453	107.5734
Bangladesh					
	GDPP	4.034	1.3908	1.5004	6.6876
	EXT DEBT	27.3494	8.466	14.971	44.4817
	INF	1.5204	0.3757	0.8800	2.1260
	POP	6.1263	2.2773	2.0071	11.395
	GNE	104.7683	1.5009	100.55	107.038
Iran					
	GDPP	1.712	3.9225	-4.968	9.2198
	EXT DEBT	8.3047	8.664	1.154	36.6870
	INF	1.5950	0.740	0.3846	3.9276
	POP	19.690	10.060	7.245	49.6559
	GNE	98.07	6.144	89.021	114.85
Bhutan					
	GDPP	5.3095	3.3149	-2.033	16.9102
	EXT DEBT	71.5058	26.9315	31.0423	117.2454
	INF	1.1458	1.644	-4.7077	2.80057
	POP	6.8453	3.377	2.4545	15.9752
	GNE	120.54	8.090	104.76	136.605

To find out the role of selected macroeconomic variables on economic growth and external debt, first of all, pooled regression model is estimated.

Table 3: Results for Pooled OLS Regression

Variables	Coefficients	Standard Error	t-value
EXT DEBT	-0.0036	0.0085	-0.86
POP	-0.7561***	0.2019	-3.74
INF	-1.464***	0.028	-5.13
GNE	0.0493**	0.024	1.99
Constant	0.918	2.73	0.34
R-Square	0.225		
Adjusted R-Square	0.2098		
Prob > F	0.000		

'*', '**', '***' demonstrates that variables are significant at a 10%, 5%, and 1% level of significance, respectively.

Table 4: Results of Fixed Effect Regression Model

Variables	Coefficients	Standard Error	t-value
EXT DEBT	-0.02272*	0.0128	-1.77
INF	-0.127***	0.2448	-1.98
POP	-0.48336*	0.0397	-3.20
GNE	0.0467	0.038	1.22
Dpak	-3.0433***	1.01	-3.01
Dnepal	-2.66***	0.783	-3.40
dsri-lanka	-0.99	0.835	-1.19
Dindia	-1.15	1.143	-1.01
dBangladesh	-1.75	1.06	-1.64
Diran	-2.838*	1.462	-1.94
Constant	3.63	4.74	0.77
R-Square	0.3133		
Adjusted R-Square	0.2775		
Prob > F	0.000		

'*', '**', '***' demonstrates that variables are significant at a 10%, 5%, and 1% level of significance, respectively.

In the present research, the F value is used to distinguish across pooled and fixed-effect models. The tabular value is 2.02, but the computed value is 0.53. Since the estimated number was smaller compared to the tabulated value, we did not reject the null hypothesis. The findings suggest that the least squares dummy variable model is suitable.

5.1 Diagnostic Test

5.1.1 Modified Wald Test

The Modified Wald test is a method to determine heteroskedasticity. The findings show that χ^2 is equivalent to 275.23, and Prob > χ^2 = 0.000. Because the p-value is below 0.05, one may reject a null hypothesis (H0), indicating that it indicates an issue with heteroskedasticity.

5.2.2 Wooldridge Test

The Wooldridge correlation test is used to discover autocorrelations. The determined value of the F statistic is 42.150, with a probability greater than F of 0.0006. As a result, the p-value is below than 0.05, allowing us to reject the null hypothesis (H0) and support the alternative hypothesis, indicating a serial correlation problem. Robust standard errors are estimated to obtain unbiased results under heteroskedasticity and autocorrelation.

Table 5: Robust Fixed Effect Regression Model Results

Variables	Coefficients	Standard Error	t-value
EXT DEBT	-0.02272*	0.0128	-1.77
INF	-0.127***	0.2448	-1.98
POP	-0.48336*	0.0397	-3.20
GNE	0.0467	0.038	1.22
Dpak	-3.0433***	1.01	-3.01
Dnepal	-2.66***	0.783	-3.40
dsri-lanka	-0.99	0.835	-1.19
Dindia	-1.15	1.143	-1.01
dBangladesh	-1.75	1.06	-1.64
Diran	-2.838*	1.462	-1.94
Constant	3.63	4.74	0.77
R-Square	0.3133		
Root MSE	2.3587		
Prob > F	0.000		

'*', '**', '***' demonstrates that variables are significant at a 10%, 5%, and 1% level of significance, respectively.

5.2 Regression Results of Robust Standard Error Model

The estimated model indicates that ceteris paribus, a 1% increase in external debt will lead to a decrease the 0.022% in economic growth. External debt has a negative significant impact on economic growth at 10% significant level. Muhanji and Ojah (2011), Serrao (2016), Siddique et al. (2016), and Kraay and Nehru (2006) also found similar outcomes and showed that external debt has a significant impact on economic growth. A nation's ability to devote more resources to profitable investments and development projects is one way that low external debt might support economic growth. A government that has minimal debt has more financial room to spend on infrastructure, healthcare, and education, which promotes economic growth. Lower debt loads also enhance investor confidence and make it easier to get financing, all of which contribute to financial stability. This in turn may encourage innovation and activity in the private sector, therefore bolstering general economic growth.

Results indicate that ceteris paribus, a 1% increase in inflation will lead to a decrease of 3.04% in economic growth. Inflation has a negative significant impact at a 1% significant level. Muhanji and Ojah (2011) also found similar results. A lower rate of inflation indicates better stability in the currency's buying power. People are more willing to spend and invest, boosting the economy, when they believe their money will appreciate over time. The cost of living is usually steadier when there is less inflation. When the rate of price increases is slower, consumers could feel more confident about their financial circumstances. An important factor in economic growth is more consumer spending, which might be a result of this confidence. Estimated results revealed that ceteris paribus, a 1% increase in population growth rate will lead to a decrease the 0.48% in economic growth. Population growth has a negative significant impact at a 1% significant level. Doğan and Bilgili (2014) also found similar results. The environmental stresses brought on by fast urbanization and resource use may be lessened by a slower pace of population expansion. Long-term economic growth may result from more sustainable economic practices as a result of this. Economic planning is possible with lower population growth rates. To meet the demands of a more steady population, businesses and governments may more precisely plan their investments in infrastructure, healthcare, and education.

Estimated results revealed that ceteris paribus, a 1% increase in gross national expenditure will lead to an increase the 0.0467% in economic growth. Godwin et al. (2016) also found similar results. Increased job prospects and greater wages can result from larger national spending. People's purchasing power rises with

income, which fuels demand and economic expansion. A multiplier impact on the economy might result from increased national expenditure. For instance, increasing consumer or government expenditure might result in higher revenue and output. Increased income leads to increased spending by businesses and families, which amplifies the original rise in expenditure by a chain reaction.

6. CONCLUSION AND POLICY IMPLICATIONS

Maintaining a low level of foreign debt is essential to fostering an atmosphere that supports economic expansion. In addition to preserving economic sovereignty, it guarantees interest rate stability, lowers susceptibility to external shocks, improves creditworthiness, allows governments to invest in important industries, and cultivates investor trust for long-term, inclusive economic growth.

There are many different ethnic groups, languages, and cultures represented in the vast and diversified population of the South Asian region. With developing markets like Bangladesh and India, the area has enormous economic potential. The demographic dividend—a comparatively youthful population—offers a chance for a strong and vibrant labor force that may spur innovation and economic progress. South Asia occupies a critical geopolitical position as the link between the Southeast Asian region, the Near East, and Central Asia. As such, it has significant influence over regional and global international affairs, impacting trade routes, geopolitical behavior, and relationships across borders.

The main aim of this study is to analyze the impact of external debt on economic growth. This study used a fixed effect regression model to point out the associations between variables. The predicted variable of this study is economic growth while the predictor variables are external debt, inflation, gross national expenditure, and population growth rate. This study collected data from the world development indicators for the South Asia Region from 1990 to 2019.

In this study, external debt has a negative significant impact on economic growth at a 10% significant level. Estimated results revealed that ceteris paribus, a 1% increase in gross national expenditure will lead to an increase the 0.0467% in economic growth. Estimated results revealed that ceteris paribus, a 1% increase in population growth rate will lead to a decrease the 0.48% in economic growth. Lastly, Results indicate that ceteris paribus, a 1% increase in inflation will lead to a decrease of 3.04% in economic growth. Inflation has a negative significant impact at a 1% significant level.

In consideration of the estimated outcomes, the following recommendations are put forward.

- In the present investigation, it is noted that external debt has a negative influence on economic growth. The government should transparently manage the entire loan phase, including project identification, evaluation permits, loan negotiations and contracting loan distribution, completion of the project monitoring and assessment, and repayment of loans. The government ought to develop a framework of credible policies to foster an environment that will promote confidence among investors, both domestic and foreign, to make investments in the nation.
- In the current study, gross national expenditure has a positive impact on economic growth. The administration should spend more money on rural transportation and power since doing so will boost productivity and improve the living conditions of South Asian people. A plan of action like this might result in the best use of resources and raise a nation's standard of life.
- In the present study, inflation has negatively contributed to economic growth. Therefore, the study suggests that the monetary authorities should make a more practical effort to aggressively control inflation to avert its negative impacts by maintaining a manageable rate that would promote economic growth in the South Asia Region.

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An Empirical Investigation of External Debt, Domestic Investment and Economic Growth in Pakistan

ABSTRACT

The current analysis focuses on how external debt and domestic investment affect economic growth by employing annual data for Pakistan from 1973 to 2022. The study also revisits the "Debt Overhang" effect in Pakistan. Data for all variables have been extracted from World Development Indicators (WDI), International Financial Statistics (IFS) and Pakistan Economic Survey (various issues). The ARDL (Auto Regressive Distributive Lag) Technique developed by Pesaran and Shin (1999) has been used for estimation after checking the stationarity of data using the ADF and PP unit root tests developed by Phillips and Perron (1988) to prevent spurious results. Results indicate that external debt has an unfavorable and statistically significant impact on economic growth confirming the presence of the "Debt Overhang" effect. Domestic investment affects economic growth positively and this relation is statistically significant. Exports of goods and services affect positively whereas the population is negatively related to economic growth. It is suggested that the government should use foreign debt for productive purposes and investments in the real segment of the economy like manufacturing, infrastructure, agriculture etc. should be prioritized by the government.

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1. INTRODUCTION

High economic growth is the main goal of developing economies. Sustainable growth in the country is essential for all economies, especially for developing countries like Pakistan. Pakistan faces different challenges including external debt, as compared to developed economies to lower its burden of debt (Atique & Malik, 2012).

External debt is very important in developing countries as it is suitable for the government to meet the monetary needs in the form of a deficit to overcome the financial gap between investment and savings. Moreover, it is also a major source of financing the resources for development. Debt can be divided into external and domestic debt. The portion of a nation's debt that is owed to international creditors, such as commercial banks, states, or international institutions, is referred to as its external debt whereas the domestic debt is funded by the lenders resident in the same country. The favourable and unfavourable impacts of foreign debt on the development of the economies have gained more concentration in economic literature (Jarju et al., 2016).

Foreign debt affects economic growth through different channels, including investment (Aziz et al., 2019). The "Debt Overhang Hypothesis "states that as debt levels increase, there is a rising trend in future taxes, which has unfavourable impacts on the investment and consumption of any nation and ultimately results in low economic growth (Jebran et al., 2016). However, for the last 50 years, foreign debt has been a major challenge for developing nations including Pakistan. Foreign debt has been the primary factor in reducing investment and growth in many countries, this relationship has been discovered during the last three decades. It is an unpleasant tax on the coming generation which they have to pay for nothing (Malik et al., 2010).

Whenever an economy faces a shortfall in saving at the domestic level, it raises the problem of current account deficit and to fill this gap of fiscal deficit economies go for loans (Riffat & Munir, 2015). Developing economies go for external loans due to the saving-investment gap. Reasons for a large amount of foreign debt are deterioration of terms of trade, the current account balance of payment deficit, uncertain political environment, poor planning, mismanagement of foreign capital (external debt), non-developmental expenditures, the high-interest rate on loans and instability in earnings of exports (Domar, 1944; Eicher et al., 2008).

Furthermore, the association between foreign debt and economic growth has been a debated topic among economists since the arrival of the debt crisis in the 1980s. Debt crises increased due to the following reasons. Firstly, the over-borrowing of developing economies and careless lending by international financial banks in the 1970s. Secondly, a rapid increase in lending rates at the international level in 1982. Thirdly, in the early 1980s, the fall down of world commodity prices especially petroleum prices (Iyoha, 1999).

Investment means an increase in capital spending and it is an essential part of total demand and the main cause of the development of any economy (Riaz & Riaz, 2017). In addition, it is an important issue of macroeconomic theory and also contributes significantly to economic growth as it promotes production methods and increases the productive capacity of the country (Saghir & Khan, 2012). Investment can be divided into domestic and foreign direct investment (Ahmad & Qayyum, 2008). Domestic investment means an investment in products and companies of someone's own country whereas the FDI is funded by anyone in different countries rather than their own country.

Moreover, investment can influence economic growth in two ways. Firstly, as investment increases, it enhances the production of goods which leads to rising economic growth. Secondly, the formation of

capital raises the productive capacity of the country which enables the economy to produce more which results in more rapid growth of the economy (Rehman & Ferdaus, 2019).

Numerous studies have been done on investment, external debt and economic growth (Maitra, 2021; Aziz et al., 2019; Adamu & Rasiah, 2017; Forgha et al., 2014) on the international level. In Pakistan lot of the research has been done on foreign debt and public investment (Din et al., 2020), Inflows of foreign capital and domestic investment in South Asian Countries (Hameed et al., 2020), Foreign debt, FDI and growth of the economy (Chaudhry et al., 2017), Foreign debt and domestic investment (Ali, 2013), Effects of foreign debt on investment and savings (Chaudhry et al., 2009), Foreign borrowings and economic growth (Awan & Qasim, 2020); (Rauf & khan, 2017); (Ali & Mustafa, 2012) and (Malik et al., 2010). To the best of my knowledge, among all these studies, no study has explored the combined association between external debt, domestic investment and economic growth in the case of Pakistan. The primary objective of the present study is to explore the relationship between external debt, domestic investment and economic growth in Pakistan. It also tries to re-visit the validity of the Debt Overhang effect in Pakistan.

The remainder of this paper is organized as follows: Section two is about the literature review. Section three consists of a model. Data and methodology, and the description of variables. Section four presents the results and discussions whereas the conclusion and policy suggestions are given in section five.

2. LITERATURE REVIEW

The relationship between external debt, domestic investment and economic growth has been investigated both theoretically and empirically. The following paragraphs present an overview of previous studies carried out in this area.

Kolawole (2024) investigated the relationship between external debt and economic growth for the period from 1981 to 2021 in the Nigerian economy. The study used the ARDL estimation technique. Findings reveal that external debt has a significant and negative impact on economic growth whereas trade openness and domestic investment have a positive effect on economic growth in the short run as well as in the long run. Real interest rate negatively affects economic growth. It is suggested that the government should borrow at zero interest rates and also borrow for investment purposes.

Ibrahim (2023) explored the impact of foreign direct investment (FDI), exchange rate and external debt on economic growth in Somalia by employing annual data from 1991 to 2020. The study used the OLS (Ordinary Least Square) technique for estimation. Findings revealed that FDI has a significant positive effect on economic growth while the external debt and exchange rate harm economic growth in Somalia. It is recommended that government should provide a suitable environment for FDI.

Dinga et al. (2023) examined the effect of external debt and domestic investment on the economic development of Sub-Saharan African (SSA) countries by employing cross-penal data from 1995 to 2018 of 35 economies. The study used the Kraay and Driscoll fixed-effect and DCCE (Dynamic Common Correlation) techniques. Results indicated that domestic investment positively affects economic development whereas foreign debt harms economic development in SSA economies. It is recommended that government should develop appropriate policies to reduce corruption and bureaucratic requirements to enhance domestic investment. It is also suggested that foreign debt should be used in productive things like infrastructure etc.

Aiyedogbon et al. (2022) investigated the effect of public debt on economic growth in Nigeria by employing the ARDL estimation technique and annual data from 1990-2020. Results explain that external

debt and external debt servicing are negatively related to economic growth. However, economic growth is positively related to domestic debt and exchange rates in the Nigerian economy. It is suggested that the government should consider more domestic borrowing for foreign debt.

Dawood et al. (2021) explored the factors that affected foreign debt in 32 transitioning and Asian developing countries from 1995 to 2019 and applied the Generalized Method of Moments (GMM) methodology. The study utilized external debt as a dependent variable whereas exchange rate, economic growth, inflation, trade openness, government expenditures and investment as independent variables. Findings showed that economic development, investment and inflation reduced foreign debt whereas trade openness, government expenditures and exchange rate increased external debt.

Later, Awan and Qsim (2020) explained the association between foreign borrowings and economic growth by utilizing the yearly data for the period 1980-2017. The ARDL (Auto Regressive Distributive Lag) estimation technique was used in the study. Findings revealed that the foreign borrowings, imports and servicing of loans had unfavourable impacts on economic expansion while the exports, formation of gross capital and labour force had positive effects on the economic growth of the country. The study explained that Pakistan must generate the resources by improving the productivity of exports raising revenue through tax and reducing the external debt.

On methodological grounds, Aziz et al. (2019) explored the effect of external borrowings and the growth of GDP on investment in low-income nations by using the Seemingly Unrelated Regression (SUR) model using an annual dataset over the period 2000-2017. The study employed a sample of 23 low-income nations, dividing them into more indebted nations (11|) and less indebted nations (12|). Results exposed that foreign debt considerably reduced the investment as well as the growth of the economy for both subsamples and the total sample. The study also looked at the association between trade openness and economic development and found that trade openness considerably increased economic growth in low-income nations.

Omoniyi et al. (2019) analyzed the relationship between foreign borrowings, FDI and growth in the Nigerian economy. The study used an annual dataset from 1980 to 2016 and the Vector Autoregressive (VAR) technique to explore the relationship between FDI and economic growth. The findings of the study revealed that only FDI and economic growth had a positive interaction. Results show that there was a unidirectional causal association between FDI and the extension of the economy.

Foreign borrowings and domestic investment can have varying effects on the growth of the economy. In a study, Adamu & Rasiah (2017) explored the impact of foreign borrowings and domestic investment on the growth of the economy of Nigeria. The study used the yearly data from 1970 to 2013. Findings revealed that there was the existence of both bidirectional and unidirectional causal relationships among independent variables. The findings also showed that in Nigeria, FDI and foreign debt both had favourable effects on economic intensification and sparked it through local investment channels. Findings concluded that domestic investment boosted Nigeria's economic growth through foreign debt.

Later in a different study, Imran et al. (2016) tested the Debt Overhang Hypothesis in Pakistan over the period 1964 to 2007. The study employed the OLS estimation methodology to investigate the empirical behaviour of servicing of external debt, employed labour force and investment economic development of the economy. Findings revealed that the servicing of debt had negative impacts on the efficiency of capital and labour that led to harmfully affecting the growth of Pakistan revealing the existence of the "Debt Overhang" hypothesis. Results indicated that in the long run an increase in output would be drained away in the form of debt service payments as external debt is an unfavourable tax on output. The study suggested that capital and labour are affected by the burden of external debt in Pakistan.

Riffat and Munir (2015) explored the non-linear association between foreign borrowing and the growth of the economy. The study also explained the channel via which foreign debt affected economic growth in South Asian economies. The study used a panel dataset on four South Asian countries from 1991 to 2013. Results showed that non-linear relationship existed between foreign debt and development in these countries. The factor productivity and public-private investment were also found significant channels via which foreign debt affected economic development.

Forgha et al. (2014) examined the effects of foreign debt and domestic investment on economic growth in Cameroon by using an annual dataset for 34 years from 1980-2013. The study used the Two Stage Least Square (2SLS) methods for data analysis. Results explained that the external debt retarded economic growth whereas domestic investment raised the economic growth in Cameroon indicating the presence of the "Debt Overhang" effect. The study also recommended that foreign debt should be used in productive activities for its positive consequence on economic growth.

Ejigayehu & Persson (2013) investigated the effects of foreign debt on growth in African economies from 1991 to 2010. The study used a Panel dataset. Estimated results revealed that the debt "Crowding-Out" effects, instead of debt overhang affected economic growth. Additionally, the data exposed that the selected countries were not paying to service of debt more than 95 % of their total debt in an attempt to distinguish debt servicing histories.

Atique and Malik (2012) analyzed an association between domestic debt, external debt, and growth in Pakistan. The study used the yearly data from 1980 to 2010. Ordinary Least Square methodology was adopted for estimation. Results explained a negative association between foreign debt and economic growth and also between domestic debt and the growth of the economy. Study suggested that foreign debt had more negative effects on economic growth as compared to domestic borrowing.

Sundell & Lemdal (2011) tested the Debt Overhang Hypothesis in developing and developed countries. The study covered the 5 indebted developed economies and 15 severely indebted developing countries during two different crises, the LDCs debt crisis in the 1980s and the Debt crisis in developed economies of the late 2000s by employing the GMM estimation technique. The findings of the study revealed that foreign borrowings harm investment and revealed the presence of a "Debt Overhang" effect in developing nations whereas in developed countries only Portugal and Greece showed a negative association between external borrowing and the development of an economy.

Malik et al. (2010) examined the relationship between foreign borrowing and growth of the economy of Pakistan. Annual data over the period 19972-2005 have been used. The study employed the OLS technique to estimate the results. The study's findings explained that foreign debt had an unfavourable significant influence on the growth of GDP. Services of debt had also unpleasant effects on the development of the economy of Pakistan. As the service of the debt increases then there would be fewer opportunities for growth of the economy.

Ayadi and Ayadi (2008) explored the influence of foreign borrowings on the economic growth of Nigeria and South Africa. Study used the annual dataset from 1994 to 2007. GLS (Generalized Least Square) and OLS (Ordinary Least Square) methodologies were applied. Results indicated that the foreign debt and foreign debt servicing harmed economic extension in both economies. The study explained effects of foreign debt on economic growth were favourable in the Nigerian economy at an optimal level after that its impact became negative reflecting a Non-linear relationship.

3. METHODOLOGY

3.1 Model

Following Forgha et al. (2014), the present study proposed the following econometric model to evaluate the impact of external debt and domestic investment on economic growth:

$$LnGDP_t = \beta_1 + \beta_2 LnED_t + \beta_3 LnGDI_t + \beta_4 LnPOP_t + \beta_5 LnX_t + \mu_{t1} \quad (1)$$

where,
LnGDP = Log of GDP Per Capita
LnED = Log of External Debt
LnDI = Log of Gross Domestic Investment
LnPOP = log of Population
LnX = Log of Exports of Goods and Services
μ_{t1} = Error Term

Equation indicates that GDP per capita is a dependent variable whereas external debt, domestic investment, exports and population were taken as independent variables. β_1 is the intercept term and β_2, β_3, β_4, and β_5 are the elasticities of external debt, domestic investment, population and exports of goods and services, respectively.

3.2 Data

The current study used an annual dataset from 1973-2022 to evaluate the effects of external debt and domestic investment on economic growth. GDP per capita is used as a dependent variable (a proxy of economic growth). Data for GDP per capita, and external debt (million US$) were obtained from World Development Indicators while data on Gross Fixed Capital Formation (GFCF) as a proxy to compute domestic investment and exports of goods and services (million US$) were extracted from International Financial Statistics. Data for the population (Million) were obtained from Pakistan's Economics Survey (various issues).

3.3 Methodological Framework

Current analysis applied the ARDL bound testing method to analyze the effects of external debt and domestic investment on economic growth. Over the earlier techniques, this technique has several advantages. It is utilized in particular for small sample sizes. Another benefit of adopting ARDL is that it can be used regardless of the order of integration of the series—order one, order 0 or a mixed order whereas the traditional co-integration techniques can only be utilized if the integration order is the same. These techniques become invalid if the series has a mixed order of integration. ARDL approach is divided into three stages. First of all, the OLS method is used to estimate the Error Correction Model (ECM) version of Auto Regressive Distributive Lag.

The general form of the model is presented below:

$$\begin{aligned}\Delta LnGDP_t = {} & \alpha_0 + \sum_{i=1}^{a} \alpha_1 \Delta LnGDP_{t-i} + \sum_{i=1}^{b} \alpha_2 \Delta LnED_{t-i} + \sum_{i=1}^{c} \alpha_3 \Delta LnGDI_{t-i} + \\ & \sum_{i=1}^{d} \alpha_4 \Delta LnPOP_{t-i} + \sum_{i=1}^{e} \alpha_5 \Delta LnX_{t-i} + \beta_1 LnGDP_{t-i} + \beta_2 LnED_{t-i} + \\ & \beta_3 LnGDI_{t-i} + \beta_4 LnPOP_{t-i} + \beta_5 LnX_{t-i} + \mu_{t1} \end{aligned} \quad (2)$$

where Δ are the first difference operator and α_0 indicates intercept. β_i denotes the long-run coefficient. α_i represents the estimated coefficients of a short run. The numbers of lag for each variable are symbolized by a, b, c, d, and e.

The next step is to determine the long-run coefficients. AIC criteria have been used to choose the lag length. The study's long-run model is as stated below:

$$\mathrm{LnGDP_t} = \beta_1 + \beta_2 \sum_{i=1}^{a} \mathrm{LnGDP_{t-i}} + \beta_3 \sum_{i-0}^{b} \Delta\mathrm{LnED_{t-i}} + \beta_4 \sum_{i-0}^{c} \Delta\mathrm{LnGDI_{t-i}} + \beta_5 \sum_{i-0}^{d} \mathrm{LnPOP_{t-i}} + \beta_6 \sum_{i-0}^{e} \mathrm{LnX_{t-i}} + \mu_{t1} \quad (3)$$

To evaluate the short-run results, following ECM model is used:

$$\Delta\mathrm{LnGDP_t} = \alpha_0 + \eta_0(\mathrm{ECM_{t-i}}) \sum_{i=1}^{a} \alpha_1 \Delta\mathrm{LnGDP_{t-i}} + \sum_{i=0}^{b} \alpha_2 \Delta\mathrm{LnED_{t-i}} \sum_{i=0}^{c} \alpha_3 \Delta\mathrm{LnGDI_{t-i}} + \sum_{i=0}^{d} \alpha_4 \Delta\mathrm{LnPOP_{t-i}} + \sum_{i=0}^{d} \alpha_5 \Delta\mathrm{LnX_{t-i}} + \mu_{t1} \quad (4)$$

ECM illustrates the dynamic rate of change from the previous year's disequilibrium to the current year's equilibrium. With a negative sign, it should be statistically significant.

4. RESULTS AND DISCUSSION

Before the estimation of regression coefficients first, we check the stationarity of data whose mean and variance do not change over time. Without checking the stationarity of data we cannot run regression otherwise results will be spurious. The present study uses time series data from 1973-2022. Time series properties of data have been checked through ADF and PP tests. Results of ADF test and PP test are reported in Table 1 and Table 2, respectively. The results of ADF and PP tests indicated that GDP, and GDI, are stationary at a level whereas ED. X and POP are stationary at the first difference I (1). Results of both tests show that variables are integrated in mixed order. When a model has a mixture of integration i.e. I(1) and I(0), so the most appropriate estimation technique is ARDL bound testing technique for long as well as short-run analysis.

Table 1: Results of ADF Test

Variables	At Level	At First Difference
LnGDP	-3.93*	---
LnGDI	-4.64*****	---
LnED	-3.0	-5.11*
LnX	-2.40	-6.15*****
Lnpop	-1.17	-7.23*****

Note: *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

Table 2: Results of PP test

Variables	At Level	At First Difference
LnGDP	-3.85******	---
LnED	-2.65	-3.88**
LnGDI	4.64*	---
LnX	-2.47	-6.14*
Lnpop	-0.99	-7.63*

Note: *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

Table 3 reports the results of the Bound Test. Results show that the F-statistics value is 7.17, which is higher than the upper bound critical value and indicates that there is co-integration among variables. As a next step, the ARDL bound testing approach is applied to estimate the long-run and short-run coefficients. The AIC (Akaike Information Criterion) is used for lag length criteria.

Table 3: Bound Test Results

F-Statistics	Critical Values		Significant	Conclusion
7.17***	3.03	4.06	10%	Cointegration
	3.47	4.57	5%	

Note: *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

Table 4: ARDL (1, 2, 0, 2, 0) Long Run Coefficients

The Dependent Variable is LnGDP Per Capita			
Variables	**Coefficients**	**Standard Errors**	**T-Statistics[P-values]**
LnED	-0.66	0.82	-3.31***** [0.00]
LnGDI	0.73	0.41	1.77******** [0.08]
LnX	0.30	0.10	2.81* [0.00]
LnPOP	-2.16	1.11	-2.61***** [0.01]

Note**:** *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

The results of ARDL long-run coefficients are reported in Table 4. Findings reveal that external debt considerably decreases the economic growth of Pakistan. The co-efficient of foreign borrowings is -0.66 and significant at 1% which suggests that a 1% rise in foreign debt causes a 0.66% fall in GDP per capita. Domestic investment significantly and favorably affects economic growth. The coefficient value of domestic investment is 0.73, which means a 1% rise in domestic investment increases economic growth by 0.73%. The coefficient of exports is 0.30, indicating that as a result of a 1% increase in exports of goods and services, GDP per capita will rise by 0.30%. Exports are positively associated with the growth of the economy. The population has negative effects on growth of the economy and is significant at 1%. A one % rise in population growth will reduce economic growth by 2.16 %.

Table 5: Error Correction Mechanism (Short run Dynamics)

The Dependent Variable is LnGDP Per Capita			
Variables	**Coefficients**	**Standard Errors**	**T-Statistics[P-Values]**
CONSTANT	5.18	0.81	6.27* [0.00]
Trend	0.01	0.00	6.22* [0.00]
D(LnED)	-0.13	0.07	-2.01****** [0.05]
D(LnED(-1)	0.20	0.06	3.20***** [0.00]
D(LnGDI)	0.33	0.10	3.27***** [0.00]
D(LnGDI(-1)	0.44	0.11	4.18***** [0.00]
ECM(-1)	-0.30	0.04	-6.32***** [0.00]
R-Square	0.65	Adjusted R-Square	0.60
F-Statistics	19.65	DW-statistics	2.22
Durbin-h	0.51		

Note: *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

The results of the Error Correction Model are given in Table 5. According to short-term statistics, Pakistan's economic growth is favourably correlated with both foreign debt and domestic investment. The positive association between external borrowings and economic progress could be because, according to Keynesian theory in the short run borrowings of the government affect demand for government securities and the level of growth positively and hence it raises private investment which promotes economic growth (Jebran et al., 2016). ECM has a value of -0.30. Model convergence toward equilibrium is shown by a negative sign, while the value indicates the rate of convergence or speed of adjustment.

Table 6: Diagnostic Test Results

Test-Statistics	LM Version	F-Statistics [P-values]
Serial correlation	-0.80[0.37]	0.60[0.44]
Functional form	1.22[0.27]	1.10[0.26]
Normality	1.26[0.53]	Not applicable
Hetroskedasticity	7.07[0.71]	0.63[0.77]

Note**:** *, ** and *** show 1%, 5% and 10% levels of significance, respectively.

The speed of adjustment from the equilibrium of the previous year to the current year is 30%. The value of R-squared is 0.60, which signifies that 65 % of variations in the dependent variable (GDP) are accounted from independent variables. The value of F-statistics is 19.65 and it demonstrates that the model is good fit. The values of Durbin-h and Durbin-Watson indicate that there is no issue of autocorrelation.

Results of diagnostic test are given in Table 6. Findings demonstrate that there is no issue of autocorrelation, Heteroskedasticity, Normality and functional form and hence the selected model is a good fit and has been correctly specified.

To check the consistency of parameters, a stability test is conducted. The null Hypothesis is that the parameters are consistent over time whereas the alternative hypothesis is that the parameters are not consistent over time. Values of the sequence that are outside of the predicted range indicate the structural change in the model over time. Both Figure 1 and Figure 2 indicate that the statistics lie between critical bounds and hence it is concluded that the parameters are consistent and stable.

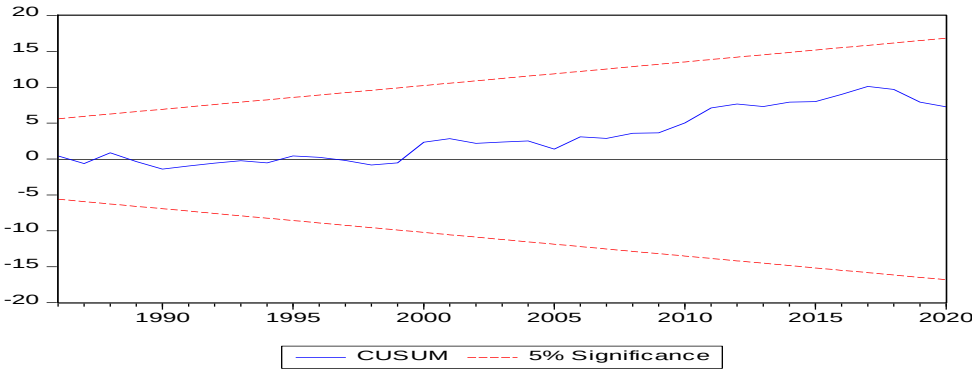

Figure 1: CUSUM (Cumulative Sum of Recursive Residuals)

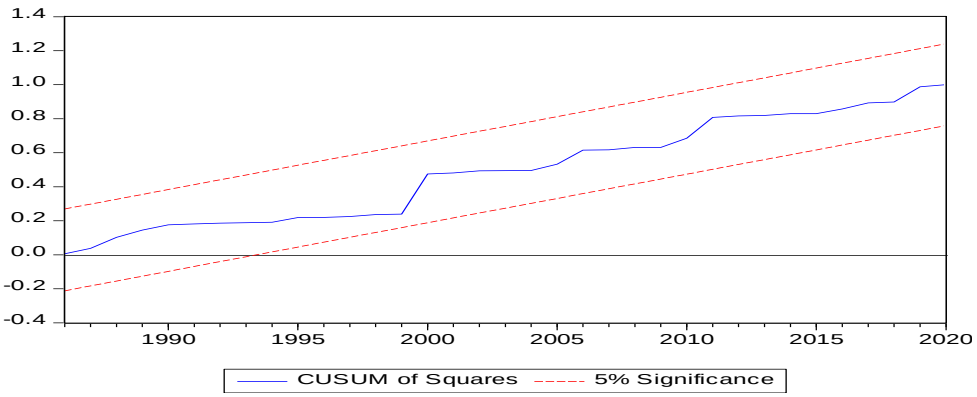

Figure 2: CUSUMSQ (Cumulative Sum of Squares of Recursive Residuals)

5. CONCLUSION AND POLICY IMPLICATIONS

Study's objective is to investigate the effects of external debt and domestic investment on economic growth in Pakistan by using annual data from 1973 to 2022. The present study also revisits the "Debt-Overhang" effect in Pakistan. After testing the stationarity properties of variables, ARDL estimation technique has been employed. Moreover, the consistency of parameters is also checked by employing CUSUM and CUSUMSQ tests in ARDL.

Findings demonstrate that external debt has a considerable negative effect on the economic growth of Pakistan as due to a one % change in external debt, there is a 0.66 % change in GDP per capita. These findings are consistent with the following other studies (see for example, Maitra, 2021; Din et al., 2020; Awan and Qasim, 2020; Forgha et al., 2014; Umiaru et al., 2013; Malik et al., 2010). The adverse impact of foreign debt on economic growth reveals the presence of the "Debt Overhang" effect in Pakistan. Domestic investment exerts a significant positive effect on economic growth in Pakistan. These Results are in line with the findings of (Maitra, 2021; Aziz et al., 2019; Adamu & Rasiah, 2017; Forgha et al., 2014). In addition, the effect of exports of goods and services is also positive on economic growth and findings are consistent with the following studies: (Forgha et al., 2014; Awan & Qasim, 2020). Furthermore, the impact of the population is negative being significant to growth of the economy of Pakistan. These results are in line with the studies of Forgha et al. (2014) and Aziz et al. (2019). There are some limitations of recent study as there are many factors affecting economic growth but this study pays attention to some macroeconomic factors and all other factors like foreign direct investment, domestic debt, corruption, Income Inequality etc. are left incorporated due to the time limit and data constraints

Present study suggests that the government should use the external debt for productive purposes to generate adequate resources to pay back the loan quickly. Also recommends that government should rely more on domestic sources generated through an increased volume of trade and domestic savings.

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The Relative Effectiveness of Fiscal and Monetary Policies on the Core and Headline Inflation: Empirical Evidence from Pakistan

ABSTRACT

The study at hands analyzes the relative effectiveness of fiscal and monetary policies on inflation in Pakistan. We have evaluated data spanning from 1980 to 2020. For empirical analysis, we have classified inflation into two categories; "Headline inflation" and "Core inflation" and the results are examined for both long run and short run time horizon. Our study utilizes total debt service, trade openness as representative of fiscal while money supply, exchange rate and remittance inflows as indicators of monetary policy. The empirical findings suggest that government debt service and money supply, both are affecting headline inflation in the long run. Nevertheless, monetary policy can be claimed to be relatively more successful determinant of long term headline inflation as compared to fiscal policy, as per determined coefficients of significant variables. The exchange rate, on the other hand, significantly influences headline inflation in the short run. The long and short run relative effectiveness of monetary policy is also evident as per our findings in terms of core inflation. The Money supply and remittance inflow emerge as statistically significant representatives of monetary policy influencing core inflation, The overall findings suggests monetary policy to be relatively more effective in terms of its impact on both Headline and Core Inflation in Pakistan.

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1. INTRODUCTION

The acceptance and popularity of any government depends on its performance and the actions taken in the benefit of general public. Individuals and Public often consider inflation rate as a key indicator for assessing policy effectiveness. The prime objective of macroeconomic policy is to attain and sustain both economic growth and price stability. Price stability is a desirable feature for every segment of the economy and constitutes a key objective of stabilization economic policies. The escalation of inflation rate has adverse effects, disrupting economic activities as a whole. Consequently, inflation and the rising price levels have emerged as significant concerns, particularly in the context of Pakistan in recent years. The surge in average price level over recent years has not only gathered the focus of policymakers but has also raised public awareness. Price stability holds a crucial position in influencing output and employment, serving as a fundamental driver of economic activities. Macroeconomic policies are pivotal in shaping the inflation rate and significantly contribute to the allocation and efficient use of scarce resources.

Hence, macroeconomic policies are a powerful tool that can be used to bring changes in resource allocation. Optimal allocation of resources relies heavily on price determination and adjustments, which in turn is crucial from perspective of economic efficiency. Current prices provide basic information regarding economic activity to economic agents while on the other side current prices also influence the economic activities and decisions of economic agents through demand and supply. Being perfectly aware and acknowledged with the role of prices play within the entire economic framework, John Maynard Keynes devoted a complete chapter in "The General Theory of Employment, Interest and Money" to the examination of price theory. Keynes believes "So long as there is unemployment, employment will change in the same proportion as the quantity of money; and when there is full employment, prices will change in the same proportion as the quantity of money" Keynes (1936). "When a further increase in the quantity of effective demand produces no further increase in output and entirely spends itself on an increase in the cost-unit fully proportionate to the increase in effective demand, we have reached a condition which might be appropriately designated as one of true inflation" Keynes (1936).

Debate and discussion on the theoretical issues regarding efficacy of fiscal and monetary policy is not new theme in the economic literature; its origin traces back to the Great Depression of 1929. This historic economic shock profoundly impacted countries globally, prompting discussions on the efficacy of monetary policy, which proved unsuccessful in reigniting economic activities during that critical period. The collapse of monetary policy and classical economy system animated Keynes to develop a doctrine. Keynes (1936) argued that the government should intervene through public investment to achieve full employment level in the long run. However, on the other side, Friedman (1960) claimed that reduction in money supply by Federal Reserve Bank was the key determinant of great depression. He argued that monetary policy remains the most effective approach to generate economic activities. Hence, Keynesians versus monetarist debate on the comparative strengths of the two policies lays a strong foundation to the subject matter of this study.

The relative effectiveness of fiscal and monetary policy for determination of inflation and price level is an ongoing and debatable issue in economic literature. Bulk of empirical studies has been conducted on this theme, but mixed results have been found regarding the relative role played by these policies. Two revolutionary works on the effectiveness of these policies were carried out in this regard, which includes work done by, Friedman and Meiselman (1963) and the second one by Andersen and Jordan (1968). Friedman and Meiselman (1963) asserted that money supply holds considerable importance as a fundamental variable in monetary policy and plays vital role in influencing economic activities. Andersen and Jordan (1968) examined the success of fiscal and monetary policy and argued that monetary policy as compared to fiscal policy is relatively more efficient in escalating economic activities. Bulk of empirical

and theoretical work in 1980's, supported and endorsed the superiority of monetary policy over fiscal policy, however few studies including Darrat (1984) and Latif and Chowdury (1998) claimed the opposite.

This paper attempts to reassess the debate of relative effectiveness of fiscal and monetary policy for inflation particularly focusing on Pakistan's economy. Earlier work on the similar themes has approached the subject matter by considering the overall inflation. Our study instead categorizes inflation into two dimensions: Headline and Core Inflation to get a more in-depth insight of the issue. Each type of inflation offers a distinct and unique aspect for policy analysis, as policies often objectively aims at achieving different things. For example; it is essential to consider headline inflation to evaluate purchasing power across different time frames. This applies to various aspects such as wages, wealth, rate of return, government transfers etc; as these factors are influenced by an aggregate measure of inflation. Hence, considering core inflation in the policy framework to adjust household income, for instance, would not be practical, given that about one-quarter of average household expenditures is attributed to food and energy consumption. Similarly, government programs are typically based on headline inflation.

However, policymakers often favor and prefer to use core inflation as a measure because it provides valuable insights into the future direction of general inflation. Consequently, current core inflation data can offer better information about future headline inflation than the current headline data itself. Headline inflation, influenced by the volatility of foods and energy prices, tends to lack robust predictive power over short periods. Additionally, their concern extends to inflationary expectations, where a rising core rate might be a more reliable indicator than a rising headline rates that inflation expectations are on the rise. This classification is also important because monetary policy and fiscal policy may have its own distinct objectives as per nature of inflation. In this contest, this paper categorizes inflation into two main types: headline and core inflation.

The primary objective of this paper is to investigate the relatively effectiveness of macroeconomic policies, specifically fiscal and monetary policies, on inflation. The approach we have followed to meet this objective involves several key aspects. Firstly, the dependent variable, inflation, is classified into headline inflation and core inflation. Secondly, the paper explores the relative effectiveness of monetary and fiscal policies over both the long run and short run. Thirdly, the analysis incorporates and specifies various representative variables on the monetary side, such as money supply, exchange rate and remittance inflow, as well as on the fiscal side, including total debt service, trade openness. Therefore, the segmented approach taken to analyze the comparative effectiveness of monetary and fiscal policies on inflation level in the case of Pakistan is a meaningful contribution to the existing literature.

1.2 Fiscal policy in Pakistan

Pakistan is grappling with political instability, a high fiscal deficit, rapid population growth, and low levels of direct investment. The government heavily relies on domestic and external borrowing to meet its budget requirements, exacerbating the country's debt burden. Economic mismanagement has led to a decline in productivity and economic growth in recent years. In response, the government passed the Fiscal Responsibility and Debt Limitations (FRDL) Act in 2005 to ensure prudent fiscal resource utilization. Efforts to increase tax collection and reduce the fiscal deficit have impacted long-term economic growth. Fiscal performance has varied over the decades, with improvement seen in the early 1990s, followed by a downturn from 1996 to 1998. Subsequently, there was significant improvement until 2004, when the budget deficit reached its lowest level at 2.3% of GDP. However, poor fiscal management led to a rise in the deficit to 7.6% of GDP in 2008. In Pakistan, reducing inflation necessitates addressing structural deficiencies in fiscal policy. Given the country's substantial debt and deficits, a robust fiscal-monetary policy approach is essential to curb inflation, especially as the recent spike is linked to the significant fiscal expansion during the Covid-19 recession. Thus, correcting fiscal policy is crucial for

inflation control, with Pakistan requiring a recalibration due to the complex nature of both conventional and unconventional inflation it faces.

1.3 Monetary policy in Pakistan

The State Bank of Pakistan plays central role in managing inflation through managing money supply growth, considering its impact on economic growth. Money supply, influenced by components like net domestic assets and net foreign assets, affects price dynamics including output and input prices. Net domestic assets reflect bank credit to the government and private sector, while net foreign assets indicate the balance of payments trend. Declining net foreign assets negatively impact the balance of payments and exchange rate, but money supply growth can be sustained through net domestic assets. Pakistan has a history of high inflation and interest rates, emphasizing the need for stable monetary policy to enhance economic development. Such policy should foster an environment of certainty to attract both domestic and foreign investors, promoting economic growth. Encouraging efficient monetary policy measures for inflation stability and attractive interest rates can contribute to economic growth. Favorable interest rates are also essential in the currency market for both international and domestic investments, thereby enhancing economic growth.

2. EMPIRICAL INSIGHTS

The role of macroeconomic policy in influencing inflation rate has been a subject of extensive debate in economic literature. Monetarists emphasize the active role of monetary policy, whereas Keynesians advocate for the efficacy of fiscal policy. Classical economists describe inflation as the uncontrolled and excessive growth in the supply of money. The classical theory of inflation states the determination of aggregate inflation level through money demand and money supply; therefore, this is also called the quantity theory of money, (Ireland, 2014). Monetarist "only money matters", believe that inflation is primarily a result of monetary factors in all circumstances Friedman & Meiselman (1963).

Smith (1956) analyzes the comparative strengths of fiscal and monetary policies and finds that the major supremacy of monetary policy over fiscal policy lies in administrative flexibility. Monetary policy can be reversed on a moment notice while fiscal policy, much more unmanageable to bring into use and implement immediately. During periods of high inflation, fiscal policy can be more effective. Governments can address inflationary pressures by enacting fiscal contraction measures such as raising taxes or reducing public expenditure. When interest rates are already low, monetary policy may struggle to rein in inflation. Hence, fiscal measures have power effects, once initiated and direct impact on the economy while, the monetary policy have indirect, relatively slow and weak impact at times of high inflation. The exploration of exact reasons and explicit causes for variations in the inflation is a dynamic research theme, which discloses disagreements prevailing in policy debates regarding determinants of inflation rate. In policy perspective, some studies have confirmed a strong association between inflation and money supply and favored monetary policy for inflation control and price stability for different countries. (Bozkurt, 2014; Raji et al., 2014; Nikolaos & Constantinos, 2013; Gali, 2018). Whereas, some others studies found the significant and strong consequences of fiscal policy variables, especially government spending and budget deficit on inflation (Fakher, 2016; Bukhari & Yusof, 2014; Darrat, 1984).

Ahmed et al. (2015) analyze the influence and impact of macroeconomic policies on price level in Bangladesh. The policies which are investigated include fiscal, monetary and trade policies. Utilizing the data spanning from 1981 to 2011 and employing autoregressive distributed lag model, the research finds that fiscal policy exerts a notable impact on both short-term and long-term price levels. The monetary policy affects the price level only in the short-term while in the long-term monetary policy seems ineffective.

Ahmed et al. (2014) analyze the factors affecting inflation in Pakistan in short-run and long-run. They have used time-series data from 1973 to 2013 and used the Johansen Co-integration technique for the empirical result. The result of this research shows that exchange rate, government borrowing, growth of money supply, indirect taxes are the important determinants of inflation rate. Furthermore, the result shows that government borrowing, indirect taxes have a direct relationship with the consumer price index, whereas exchange rate and import price index are also positively related with the consumer price index. The result settles in favor of both policies (fiscal and monetary) having their due relevance for affecting inflation. In a recent study, Asandului et al. (2021) evaluate the asymmetric effect of fiscal policy on inflation and economic activity and report that fiscal policy influences inflation and economic activity negatively in the short run. Similar results have been found in a study by Jørgensen and Ravn (2022), which reports indirect response of prices against positive shock in government spending.

Akram et al. (2011) investigated the relative influence of monetary and fiscal policies on price level determination in Pakistan. They examined domestic debt, fiscal deficit, money supply, and exchange rate variables using granger causality, VAR, and impulse response function techniques. Their findings indicated that both policies exert a significant impact on the price level, with fiscal policy demonstrating stronger direct and indirect effects. This conclusion aligns with the findings of a previous study by Javid et al. (2008). Utilizing annual data from 1973 to 2012 sourced from the Pakistan Economic Survey and the State Bank of Pakistan, the analysis revealed that 15.2% of price variation is explained by money supply, 14.62% by exchange rate, 14.3% by fiscal deficit, and 15.6% by domestic debt, while the remaining 40.2% is attributed to inflationary expectation.

Bashir et al. (2011) examine the determinants of consumer price index using Johansen Co-integration and Vector Error Correction estimates for both the long-run and short-run results. The study concludes that the consumer price index have positively association with money supply, GDP and government expenditure while government revenue have negatively correlated with the consumer price index.

Jongwanich & Park (2008) analyze the relative significance and importance of various sources of inflation and also examine the role of external price shock in inflation determination in developing Asia. Results of the study reveal that inflationary expectations and excess aggregate demand are two crucial determinants of inflation accounting for about 60% of Asia's inflation. Whereas, external prices shock have been found as insignificant and explained less than 30% inflation in Asia. Moreover, monetary policy has been found dominant and influential tool against inflation in developing Asia. However, monetary policy has been reported as less successful against cost-push inflation while found effective against demand-pull inflation. Exchange rate is nevertheless less important and has been explored as significant determinant of inflation.

Lima and Dash (2021) investigated macroeconomic policy impacts on inflation in Cambodia. They discovered several key findings. They observed a negative relationship between exchange rates and public spending with consumer prices, while money supply has a positive effect on consumer prices over the long term. Furthermore, they noted that public spending growth significantly influenced inflation rates in the short term, whereas, broad money has no short term impact on inflation rates. Their findings highlighted the importance of exchange rates, public spending expenditure and broad money in shaping inflation in Cambodia. The researchers concluded that fiscal policy demonstrated greater effectiveness and played a significant role in affecting short term inflation rates, while monetary policy was more effective and impactful on long term inflation rates.

Naikoo et al. (2021) analyzed the impact of monetary policy on housing prices in India. Monthly data was used covering period from January 2009 to December 2018 and Autoregressive Distributive Lag (ARDL) techniques was employed for estimation. The results showed that monetary policy has limited impact on

housing sector prices. Henceforth, the researchers concluded that monetary policy is insignificant to control real estate prices. Lim and Papi (1997) utilized time series data covering period from 1970 to 1995. The empirical results point out that money supply, wages, price of imports and exports are positively associated with inflation, whereas, exchange rate is inversely affect inflation rate in Turkey.

Schnabel (2022) signified that monetary and fiscal policies may diverge, leading to a less than ideal policy combination. Fiscal measures such as subsidies may lead to exacerbate medium term inflation, prompting monetary policy to raise interest rate. Henceforth, the researcher suggests that long term impact of government actions on inflation should be considered. The findings of the study highlight that monetary policy can contribute most effectively to macroeconomic stability through safeguarding people's purchasing power and promoting investment by reducing uncertainty.

Astuti and Udjianto (2022) assess the impact of monetary and trade policies on inflation and economic growth across four ASEAN countries. The findings of the study demonstrate that monetary policy may leading to dampen economic growth initially in short term, nevertheless, yields strong positive effects in the long term. Furthermore, the study findings emphasize the successfulness and significance of monetary policy and underscore its robust impact, particularly when aligned with trade policy coordination.

Raza et al. (2023) evaluate the various channels through which monetary, fiscal and income policies impact inflation and output in a small open economy, using Denmark as a case study. They employed a stock flow consistent model based on sectoral data. Henceforth, the research replicates the post Covid-19 inflationary environment faced by Denmark and other nations. With monetary tightening as a forced policy response due to a fixed exchange rate regime, the study explores several policy options within existing framework to mitigate inflationary effects. The findings suggest that close coordination between fiscal and income policies can alleviate income shocks without exacerbating inflation. Additionally, the study highlights that among the policies analyzed, monetary policy has the most significant impact on public debt sustainability.

The study conducted by Adim (2021) demonstrates a long-term association between Money Supply and Inflation in Nigeria, the research data spanning from 1980 to 2011. Additionally, the findings indicate that both money supply and interest rates positively influence inflation, along with government expenditure and the exchange rate showing a positive correlation with inflation

According to the study conducted by Istinganah and Hartiyah (2021), their research findings, based on data spanning from 1978 to 2017, suggest that foreign debt has a lasting impact on inflation. The results imply that over the long term, inflation tends to rise concurrently with increases in external debt, and vice versa. Consequently, they advise against Indonesia, as a developing nation, relying on foreign debt, as it does not enhance domestic economic conditions. However, despite this recommendation, Indonesia's foreign debt continued to rise during the period from 2010 to 2019.

Olasunkanmi and Oladipo (2020) examine the factors, both domestic and external, influencing inflation in Nigeria utilizing the Seasonal Autoregressive Integrated Moving Average with Additional Explanatory Variables (SARIMA-X) method. Given the predictability of past inflation series and the inherent seasonal patterns in Nigerian inflation, the SARIMA-X approach is employed. The research estimates and assesses three models for different types of inflation (headline, food, and core), revealing the interplay between domestic and external factors impacting inflation in Nigeria. The study highlights that the average prices of premium motor spirits (PMS), total rainfall, and any shocks affecting either food or core inflation, or both, have an immediate effect on headline inflation. Particularly, the external factor of fuel prices emerges as a significant determinant.

Kuma and Gata (2023) explored the determinants of food price inflation in Ethiopia, data covering period from 1990 to 2021. The researchers employed the Autoregressive Distributed Lag Approach (ARDLA). The results signified that several variables, including money supply, exchange rate, and interest rate, real GDP, world food prices, rainfall, and population are co-integrated in the long run. Specifically, in the long run, real GDP and lagged world food prices have a negative and significant impact on food price inflation, while domestic food prices, annual rainfall, interest rates, and money supply have a positive and significant effect on food price inflation.

3. METHODOLOGY AND DATA

3.1 Theoretical Framework

The classical economist Fisher (1911) argues that velocity and transaction are constant and price level and inflation are only determined in proportion to money. Later on, after the development of this theory by Cambridge economists like Pigou (1917) and Marshall (1923), they assumed that velocity and circulation are not constant and the purchasing power is inversely correlated with price level. Classical claims that excess money in circulation growth as believed by Fisher, is the essential factor for the inflation determination. Keynesian has introduced a new monetary theory which is different from Classical. According to Keynesian approach, when full employment level is not achieved and there is unemployment then the price levels are not affected by the growth of supply of money. Hence, Keynesian economists believe that inflation is primarily determined by demand factors, excess aggregate demand, cost of production and production level. Monetarist "only money matters", believe that monetary factors are the major determinants of inflation. Friedman and Meiselman (1963). "I don't think monetary policy has to be backed up by fiscal policy at all. I think monetary policy can curb inflation" (Friedman, 1981). Friedman (1987) observed that the link between inflation and fiscal policy hinges on the method of financing government spending. Specifically, he recommended that government spending can lead to inflation if it is financed and funded through money creation.

3.2 Empirical Models

In order to achieve the objectives of our study and to test the proposed hypothesis, the following empirical models have been formulated.

$$LNHINF_t = \alpha_t + \beta_1 LNM2_t + \beta_2 LNER_t + \beta_3 LNGDP_t + \beta_4 LNTDS_t + \beta_5 LNOILP_t + \beta_6 LNTO_t + \varepsilon_t \quad (1)$$

Equation 1 presents an empirical model which is designed to assess the comparative effectiveness of fiscal and monetary policies on headline inflation, whereas LNHINF represents the natural log of CPI.

$$LNCINF_t = \alpha_t + \beta_1 LNM2_t + \beta_2 LNER_t + \beta_3 LNTDS_t + \beta_4 LNGDP_t + \beta_5 LNRM_t + \varepsilon_t \quad (2)$$

Equation 2 presents is empirical model which aims to analyze the relative effectiveness of fiscal policy and monetary policy on core inflation.

3.3 Data and Variable Description

3.3.1 Variables Description

This paper attempts to analyze the impact of monetary and fiscal policy on inflation level dynamics in Pakistan. Hence, to obtain robust results, inflation is categorized into headline and core inflation. Therefore, the selection of variables in this paper is not an adhoc, arbitrary and based on some rationale, keeping in view the paper objectives. This paper used all variables in log form.

Headline Inflation (LNHINF): One of the empirical models (Equation 1) is formulated to evaluate the relative impact of fiscal and monetary policy on headline inflation. Headline inflation gauges the fluctuation in the cost of goods and services. It is used for capturing an aggregative and consolidated outlook of inflation within the economy. Headline inflation includes high volatile goods like energy and food items. Therefore, the prices of these items make headline inflation more unstable and volatile. Consumer price index (CPI) is commonly utilized as an indicator of headline inflation.

Core Inflation (LNCINF): Our second empirical model (Equation 2) is formulated to evaluate the relative successfulness and influence of fiscal and monetary policy on core inflation. Core inflation calculates the fluctuations in the prices of goods and services while excluding high volatile items like food and energy and usually this providing a measure of the economy's underlying long-term inflation trend.

***Money Supply (M2)*:** Classical economists and monetarists believe that inflation rate is solely determined by supply of money in the long run and is positively related. However, Keynesian literature rejects this view and claim that aggregate demand is the only determinant of inflation rate dynamics. This study will use M2 broad money. M2 or broad money encompasses a wider spectrum of the money supply, incorporating liquid assets that are readily convertible into Cash; therefore, it provides a more comprehensive measurement of the money supply. Past studies show that this variable is positively related to inflation level dynamics and inflation.

Exchange Rate (LNER): The **e**xchange rate is negatively and indirectly related with the inflation rate in the long-run and short-run. This study uses the real effective exchange rate. It assesses a country's currency value by comparing it to a weighted average of its major trading partners' currencies. Hence, it reflects a nation's international competitiveness relative to its trading partners. Economists and policymakers prioritize the real effective exchange rate for evaluating a currency's overall alignment. This variable is taken in natural log form. This variable was used by (Nguyen, 2019), and (Qurbanalieva, 2013).

Remittance Inflow (LNRM): Remittance inflow significantly influences the dynamics in price level positively in the long-term and short-term. The rise in remittance raises domestic demand and resultantly, prices moves upward. (Qurbanalieva, 2013) and (Ahmed, 2014). This variable will be taken in percentage.

***Total Debt Service (LNTDS)*:** Research shows that domestic debt influences inflation rate directly and indirectly through the supply of money. Moreover, high and large debt levels and their slow adjustment process strongly influence the inflation rate negatively. This study taken total debt services as percentage of GNI as used as government debt. This variable was also utilized by (Akram et al., 2011; Woodford, 1998) in their research studies.

***Trade Openness (LNTO)*:** Past studies found that trade openness exhibits negative association and significantly affects the inflation level dynamics in the long-run. This present study will use trade intensity (TI) for trade openness as employed by Ahmed *et al*. (2015). Trade intensity is defined as the ratio of import plus export divided by GDP.

***GDP (LNGDP)*:** The inflation rate shows greater sensitivity to changes in income and GDP over both short and long timeframes. As a result, GDP is seen as the more pivotal factor, with a negative relationship to inflation rate dynamics. This study will use real GDP in national currency. This variable was employed by (Ahmed, 2014; Ahmed *et al*., 2015) in their studies.

Oil Price ((LNOILP): Oil price is directly correlated with price of energy items and negatively related with productivity. Oil price also affects wages, profits, inflation, investment and employment through productivity. Oil is the 2nd largest source after natural gas of energy. This variable was used by (Qurbanalieva, 2013). Hence, average annual crude oil price per barrel is used in this study.

3.3.2 Data and Data Sources

This paper utilized the latest available time series annual data of Pakistan from 1980 to 2020 which are taken from both official national and international secondary sources. Inflation data (CPI) have been collected from Price Section, Pakistan Bureau of Statistics (PBS). Moreover, core inflation data are taken from FRED Graph Observations, Federal Reserve Economic Data. However, other variables used in this paper as independent variables including money supply (Broad Money, M2), exchange rate, total debt service, trade openness, GDP and crude oil price are taken from World Development Indicators; (WDI), World Bank and International Financial Statistics (IFS), International Monetary Fund, respectively.

Results and Discussions

Prior to formal analysis of Vector Error Correction Estimates (VECM), Johansen Co-integration Test and ARDL, first we need to examine the integration order of variables under consideration. Therefore, we utilized two tests for unit root namely; Augmented Dickey-Fuller Test and Phillips-Perron test. All variables have been transformed into logarithmic form and intercept are incorporated in each specification at both the level and at first difference. We do not reject the null hypothesis at level; however, we reject the null hypothesis and accept the alternative hypothesis at the first difference. Conclusively, the results provided by the ADF and PP test of stationarity demonstrate that all variables employed by this paper are integrated of order one, I (1), except core inflation which stationary at level and series is free of order two or above. Therefore, we proceed with the Vector Error Correction Estimates (VECM), Johansen Co-integration test and ARDL.

Table 1: Unit Root Tests Results

	Augmented Dickey-Fuller Statistic		Phillips-Perron Statistic	
Variable	Level	First Difference	Level	First Difference
	t-Statistic	t-Statistic	t-Statistic	t-Statistic
LNM2	-1.7092	-5.5772***	-1.7207	-6.9258***
LNSR	-1.6767	-7.2423***	-1.6767	-7.3568***
LNGDP	-2.0754*	-3.0997**	-2.9867*	-3.0878**
LNER	-1.9559	-5.1651***	-1.9559	-5.1650***
LNTO	-1.9762	-6.7270***	-1.9683	-6.7406***
LNTDS	-2.0367	-8.6264***	-1.8372	-8.8052***
LNOILP	-1.2610	-4.7723***	-1.3082	-5.5919***
LNHINF	-2.7296*	-6.5232***	-2.9303*	-6.5247***
LNCINF	-3.9704**	-8.6321***	-4.0213***	-5.632***

Note: ***p-values < .01, **p-value < .05, and *p-value < .1.

This paper employs two techniques, namely the Johansen Co-integration Test and VECM model to estimate equation 1 (empirical model 1), the relative effectiveness of monetary and fiscal policy on headline inflation. Result of Johansen Co-integration Test with headline inflation as dependent variable is displayed in Table 2.

Results based on Trace method that suggest two co-integrating relationships among the variables under consideration. Furthermore, the empirical results based on VECM regarding the relative effectiveness of monetary and fiscal policies on headline inflation are displayed in Table 3.

Table 2: Johansen Co-integration Test Results: Empirical Model 1 (Response of Headline Inflation)

Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None *	0.7706	164.7350	125.6154
At most 1 *	0.6748	107.3058	95.7536
At most 2	0.5306	63.4854	69.8189
At most 3	0.3484	33.9833	47.8561
At most 4	0.2465	17.2776	29.7970
At most 5	0.0999	6.2403	15.4947
At most 6	0.0533	2.1352	3.8414

Note:* represent existing of cointegrating equation

Table 3: Vector Error Correction Estimates

Panel A: Long-run Estimates: Empirical Model 1 (Response of Headline Inflation)		
Variable	Coefficient estimates	t-Statistic
LNM2	-4.3822	-4.5248***
LNER	0.9972	1.9446*
LNGDP	0.9706	2.1432**
LNTDS	0.9092	3.0815***
LNOILP	0.6482	3.9349***
LNTO	-2.8159	-3.0968***
Panel B: Short-run Estimates: Empirical Model 1 (Response of Headline Inflation)		
Error Corrections	Coefficient estimates	t-Statistic
ECM	-0.3742	-2.8657***
D(LNHINF)	0.0048	0.0278
D(LNM2)	0.0115	0.0100
D(LNER)	-2.0964	-2.0760**
D(LNGDP)	3.2684	1.0458
D(LNTDS)	0.2771	`1.1287
D(LNOILP)	0.4664	1.8971*
D(LNTO)	-0.2596	-0.2805
CONST.	-0.2040	-1.3451

Note: ***p-values < .01, **p-value < .05, and *p-value < .1.

Panel A: The result of the Vector Error Correction Estimates (VECM) in panel A of Table 3 shows that the dependent variable headline inflation has long run relationship with macroeconomic policy variables. The findings suggest that both monetary and fiscal policy variables hold significance and affect the dependent variable headline inflation in long run. Moreover, the results suggest that money supply and trade openness are positively associated with headline inflation whereas, government debt service, GDP and oil prices are negatively affect the target variable, headline inflation. For example, GDP is significant variable and affect the inflation negatively, one percent change in GDP would result 0.97 percent decrease in inflation. However, the results concluded that monetary policy is relatively more efficient and effective to handle headline inflation over the long term. This same result was documented by Nguyen (2019); Awan & Imran (2015) and that money supply and monetary policy have significant role in affecting inflation level. This empirical result supported the monetarist doctrine.

Panel B: The VECM results based on where LNHINF, LNM2, LNER, LNGDP, LNTDS, LNOILP and LNTO correspond respectively to headline inflation (CPI used as headline inflation), exchange rate, money supply, gross domestic product, total debt service, oil price and trade openness. VECM results suggest that error correction coefficient is negative and statistically highly significant showing the ability to converge back towards long equilibrium in case of disequilibrium. The probability value of result reveals that exchange rate is statistically significant and affects the headline inflation in short run. A one percent rise in the exchange rate would leads to decease 2.09 percent headline inflation in short run. Moreover, oil price is significant at 10%, however, all others variables are not significant and do not play role to affect headline inflation in short run. The result indicates that monetary policy is more successful and effective to handle headline inflation in short term. The identical result reported by; and Qurbanalieva (2013). This paper also examines the responses of headline inflation to one unit change in other policy variables. The Response of headline inflation is presented in figure 1.

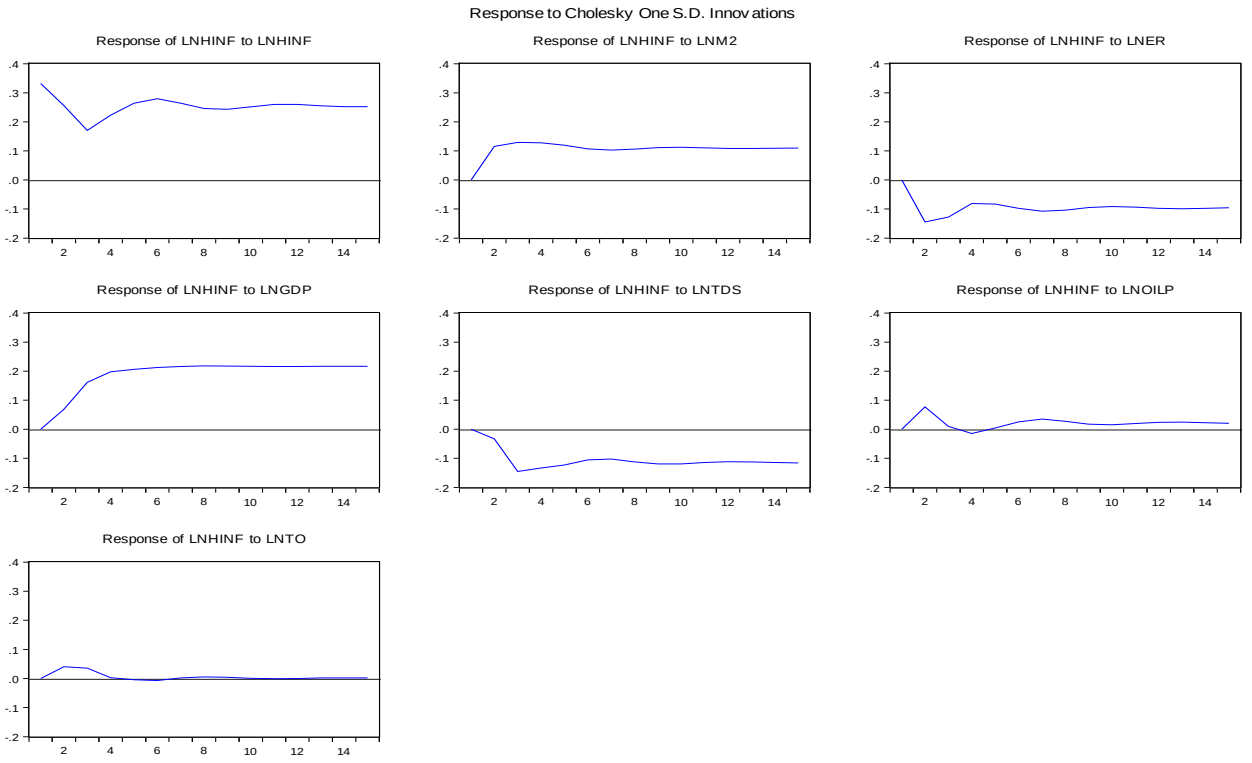

Figure 1: Response of headline inflation to one-unit change in other policy variables

Estimation of impulse response functions based on VECM for headline inflation equation is shown in figure 1, where LNHINF, LNM2, LNER, LNGDP, LNTDS, LNOILP and LNTO correspond respectively to headline inflation (CPI used as headline inflation), money supply, exchange rate, gross domestic product, total debt service, oil price and trade openness. The duration of the shock or time horizon is measured on x-axis while the intensity and direction of the shock is measured on y-axis. The graphs in the first line indicate the response of the headline inflation (CPI) to a unit change in headline inflation (CPI) itself and to one standard deviation shock in exchange rate, gross domestic product, money supply, and oil price and total debt service. Here we are interested in the interpretation of the reaction of headline inflation (CPI) to a unit change in other variables included in the VECM equation.

The graph in the top left corner of figure 1 shows that in response to unit shock in headline inflation (CPI) in first period, headline inflation decrease until period 3 and so the effect of the unit shock never die out thereafter. This means that a unit shock to headline inflation increases headline inflation throughout the

sample period. Similarly, headline inflation remains negative throughout the sample period as a response to a unit shock in exchange rate. This means that headline inflation and exchange rate are inversely related after a unit shock to exchange rate. An uptick in the supply of money leads to raise headline inflation throughout the sample. This finding aligns with theoretical framework, as higher money supply is always associated with higher inflation. However, as the results shows the response of headline inflation to a unit change in log of oil is ambiguous and seems irrelevant. This is not supported by the results of other studies where the two are positively related. The intuition is that higher inflation leads to higher oil prices where the results are true for both developed and developing economies (Choi et al., 2018). Lastly, the response of headline inflation to one unit change in total debt service remains significant but negative through the sample period.

Core Inflation: Core inflation provides a stable measure of long-term inflation trends, representing the general price movement in the economy. This paper aims to analyze the influence of monetary and fiscal policy on core inflation. The variables included in our model 2 offers a mix of I(1) and I(0) variables, therefore, ARDL model is being used . ARDL Bounds test outcome is given in Table 4.

Table 4: ARDL Bounds Test Results: Empirical Model 2 (Response of Core Inflation)

Test Statistic	Value	K
F-statistic	5.7334	5
Critical Value Bounds		
Significance	Lower Bound	Upper Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

The F-statistic value is 5.7334 which is greater than the critical value of upper bound that is 3.79 at 5% level, so, we can concluded that co-integration exists between the variables of interest. The empirical findings derived from the ARDL analysis are reported in Table 5.

Table 5: ARDL Test Result: Empirical Model 2: (Response of Core Inflation)

Panel A: Long Run Coefficients		
Variable	Coefficient estimates	t-Statistic
LNM2	-2.3430	-0.8858
LNER	-9.1725	-2.5374**
LNTDS	-1.0764	-1.1603
LNGDP	3.8190	1.3207
LNRM	-0.7882	-0.8623
Panel B: Co-integrating Form		
Variable	Coefficient estimates	t-Statistic
D(LNM2)	-6.2847	-3.0008***
D(LNER)	-1.1645	-0.3676
D(LNTDS)	-0.2769	-0.4452
D(LNGDP)	3.3536	1.4386
D(LNRM)	-2.0601	-2.2638**
ECM	-0.8781	-3.3403***

Note: ***p-values < .01, **p-value < .05, and *p-value < .1.

Long run analysis: Panel A shows long run analysis where LNM2, LNER, LNTDS, LNGDP, and LNRM correspond respectively to money supply, exchange rate, total debt service, gross domestic product and remittance inflow respectively. The probability value suggests that exchange rate is the sole monetary instrument that holds statistical significance at 5% level and affects the core inflation in the long term. Remaining others factors are insignificant in long run and do not play any role to influence the core inflation in the long run. Insignificance of money supply supports the Keynesian claim. As Keynesians argue that when full employment hasn't been achieved, employment will fluctuate in line with changes in the quantity of money. The empirical findings of this paper are supported and matching findings have been reported by Nguyen (2019), and Qurbanalieva (2013).

Short run analysis: Panel B shows that error correction coefficient is negative and statistically highly significant showing the ability to bounce back towards long equilibrium in case of disequilibrium situation. The ARDL results suggest that money supply and remittance inflow, both variables are significant at 5% level in affecting the core inflation in short term in Pakistan. All others variables are insignificant to affect core inflation in short term in Pakistan. The same findings have been reported by Awan and Imran (2015), Ahmed et al. (2014), and these findings favor a supported the monetarist claim that inflation is a monetary phenomena. Require coordination of policies, however, monetary policy is less important.

4. CONCLUSION

Empirical findings signified that in the long term, headline inflation in Pakistan is primarily affected by changes in money supply, government debt, trade openness, oil price and GDP. The empirical results suggest that both fiscal and monetary policies are important to affect headline inflation in long run. Moreover, with monetary policy playing an essential role, as evidenced by the higher coefficient value of money supply compared to government debt service. This empirical result suggests that coordination of monetary and fiscal policy is successful in stabilizing prices; however, this also indicates that fiscal is less important and have minimal role in inflation control. Additionally, exchange rate exerts a notable influence on headline inflation in the short term. Regarding core inflation, the exchange rate emerges as the sole significant factor in the long run, while short-term effects are predominantly driven by money supply and remittance inflows. Hence, the empirical results suggest that monetary policy playing significant role in affecting core inflation and support monetarists claim. Overall, the results underscore the stronger power of monetary policy to affect both headline and core inflation, persisting in both short and long-term contexts in Pakistan. Ahmed et al. (2014) and Nguyen et al. (2019). Schnabel (2022), Astuti and Udjianto (2022) and Raza et al. (2023), all documented identical results in their respective studies and suggested that monetary policy have stronger role and relative more successful and effective in affecting inflation and stabilizing prices.

High inflation is a signal of macroeconomic instability. So, price stability is an essential instrument for bringing stability in financial sector. Stable financial sector is essential for economic growth. Subsequently, policy recommendations are required for curtailing the magnitude of government consumption expenditure and debt indicators and enhancing the economic productivity as these three fiscal policy instruments are high significant and plays important role in affecting price level dynamics. Similarly, measures should be taken to enhance the remittance inflow, for the stability of exchange rate, to maintain the maximum level of saving rate and excess money supply for debt should be avoided. Henceforth, in summary, pursuance of prudent of monetary and fiscal policy is mandatory for maintaining the optimum level of inflation level. For this, Pakistan require to:

(i) Maintain the minimum level of government debt and financing the debt through non-debt sources like exports, foreign aid and foreign direct investment as results show that debt is basic cause for inflation.
(ii) It is necessary to take steps to minimize the government consumption and non-developmental spending as these divert resources from productive channels to non-productive areas.
(iii) Results findings suggest that stable currency leads to stable exchange rate, plays central role while handling the higher inflation and price level fluctuations. Therefore, government may adopt policy and measures to maintain the exchange rate stability and avoid the devaluation and depreciation without proper study and research.
(iv) Results suggested that money supply is an essential monetary policy instrument and badly impact the price level, therefore, government should make sure to avoid the seigniorage practice.

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