Is hike in inflation responsible for rise in terrorism in Pakistan?

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Is Hike in Inflation Responsible for Rise in Terrorism in Pakistan?

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Abstract: This paper investigates the static and dynamic effect of inflation and economic growth on terrorism using annual frequency i.e. 1971-2010 in case of Pakistan. In doing so, ARDL bounds testing approach to cointegration has been applied while robustness of long run relationship is confirmed by using rolling window approach. The empirical evidence confirms cointegration between inflation, economic growth and terrorism in Pakistan. An increase in inflation raises terrorist attacks. Economic growth is also a major contributor to terrorism. Moreover, bidirectional causality is found between inflation and terrorism as investigated by VECM Granger-causality approach while variance decomposition also supports the findings by VECM analysis.

Keywords: Inflation, Terrorism, Cointegration

I. Introduction

Many definitions of terrorism are available in economics but the most frequently used is a combination of three elements (i) use of extreme violence, (ii) nature of terrorist acts by individuals and organizations (Nasir et al. 2010), and (iii), publicity (Llussa and Tavares, 2007). Terrorism is said to be known as the intentional exercise of peril and warning to practice violence by an entity versus opponents in order to achieve personal, social, economic and political gains by pressure of a significant addressee ahead of the actual and direct sufferers (Endler and Sandler, 1993, 2000, 2006). The components of terrorism comprise of bullying, violence and social, political and ideological aims. The terrorist attacks tend to be hit and miss as well as arbitrary to create strain in the atmosphere along with the addressees. This, in turn, leads the government representatives to connect with the terrorists and make a settlement (Yildirim et al. 2007). Despite the consideration of many aspects of terrorism in defence economics, the influence of terrorism has not been seen in terms of inflation as well as economic growth in case of Pakistan which has faced the most horrible terrorist activities in the world after 9/11.

The objective of the study is to investigate the effect of inflation and economic growth on terrorism or terrorist attacks in case of Pakistan. Our findings show that a rise in inflation raises terrorist attacks and economic growth also contributes to increase the terrorism while causality analysis indicates bidirectional causal relationship between inflation and terrorists' incidents in the country. The study has four contributions in defence literature: (i) an effort to fill gap in defence literature regarding Pakistan, (ii) Clemente-Montanes-Reyes (1998) and Zivot-Andrews (1992) structural break unit tests are used to check the

order of integration of running actors, (iii) rolling window approach is applied to test the robustness of long run relation between the variables established by ARDL bounds testing approach and direction of causal relation is investigated by applying VECM Granger-causality approach.

Impact of Inflation on Terrorism

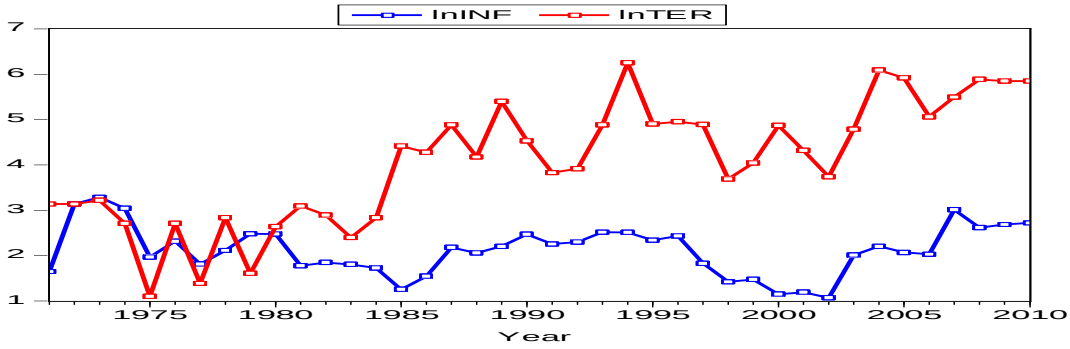
Inflation plays a vital role in macroeconomics management. In the light of classical theory, it is argued that money supply or prices have no impact on the real variables of an economy. In real term inflation has no impact on resource allocations and economic efficiency under perfect competition as economy works at full employment level. Keynes discussed the influence of inflation under, over and above national income equilibrium due to monolopolistic behavior of the producer. High inflation in an economy may cause un-equalized allocation of resources. Earlier theories of inflation discuss the relationship between unemployment and wage rate. While in the favor of classical arguments' Friedman (1960) argued that inflation is a monetary phenomenon and has no real impact on the macroeconomic variables. Furthermore, Mankiw (2003) pointed out that "most people earn their income by selling their services and labor costs rise with inflation therefore inflation does not itself reduce people's purchasing power".

The real income or purchasing power of the people is determined by their productivity which in turn depends on the availability of physical capital, human capital, natural resources and production technology to be used for production process. On the other hand, nominal income is determined by inflation rate which depends on the growth of money supply. Inflation, caused by growth of money supply, taxes the society through

shoe-leather costs, anticipated inflation costs, men costs and may as well cause macroeconomic inefficiency in resources allocation. Theory of rational expectations by Lucas (1972) reveals that people may be temporarily confused in decision making regarding savings, investments, wages and income in real terms. The effects of an unanticipated expansion of money supply or price level works non-neutral. This situation may put pressure on the poor segment of the society by reducing their purchasing power and as a result they are further forced down the poverty trap (Dornbusch et al. 2006)[1]. In such an environment, poor are more vulnerable to rising inflation compared to elite class of the population. This creates problems for entire population but leaves the poor struggling to meet ends.

Under such circumstances, the opportunity cost of life reduces making terrorism a plausible course of action for the poor to achieve necessary resources. In fact many will tradeoff their own lives to generate financial resources for their families[2] which pursue them for terrorist acts. Many researchers have debated over many issues regarding terrorism in defence economics [Berman, (2003); Epstein and Gang, (2004); Glaeser, (2005); Charney and Yakatan, (2005); Berman and Laitin, (2005); Ferrero, (2006) and, Llussa and Tavares, (2007) but this particular issue i.e. effect of inflation of on terrorism is ignored in defence economics. This study is a humble effort to fill the gap and may be a good contribution in literature regarding case study of Pakistan.

Figure-1: Trends in Inflation and Terrorist Attacks in Pakistan



Pakistan's economy is characterized by low economic growth (4.1%), high unemployment rate (15%) and high inflation rate (13.4%) in 2009-10. Improper planning and implementation of economic policies, deteriorating law & order and governance situation, deficit in balance of payments, high levels of nonproductive military spending, rising external and internal debt and high debt services on external debt have all inversely affected the economic growth.

The high unemployment rate in the country is due to backwardness of agriculture (more than 90% population of village economy is involved in agriculture and related activities). The demand of unskilled labour in industrial as well as agro-related sectors has decreased due to adoption of advanced technology and there are lesser job opportunities for the unskilled labour. This situation has increased income inequality and hence poverty (more than 40% population is living below the poverty line) in the country. Governments have not paid due attention towards establishment of technical institutions to train unskilled labour. The government expenditure on security has been increasing since 2001 at the cost of development expenditures. Industrial sector has not contributed much to absorb the increasing rate of labour force due to electricity short fall in the country for last five-

six years. In fact, electricity short fall has affected already established industry and the unemployment rate has increased. Moreover, low quality and high cost products by agriculture and industrial sectors have declined demand for goods and further contributed to increased unemployment and no attempt was initiated to overcome this crucial issue.

Power shortages not only affected the industrial sector but distressed the economy as a whole. In addition, limited availability and high cost of basic production inputs i.e. electricity, natural gas and oil etc have closed many running industrial set ups. The corrupt tax system adds to the problems by not collecting sufficient revenue to spend on developmental projects. Historically the government has tried to fill budget deficit by increasing indirect taxes rather than direct taxes which declined investment and employment opportunities. Such an environment affected investment opportunities and international financial crisis further increased unemployment due to insufficient foreign direct investment. Fiscal policy has not been encouraging and monetary policy also played its role by increasing interest rates which raised the cost of loans resulting in decreased investment and increased unemployment rate.

The population growth rate at1.8% is considered the highest in the region and is putting pressure on household income through increased demand. Inefficient legal system has allowed for hoarding and smuggling practices that has furthered the inflationary pressure in Pakistan. The rising prices of electricity, gas and oil also played their role to increase cost of production that further increased inflation. The coalition of Pakistan with USA to fight against terrorism affected fiscal policy and major chunk of resources, diverted away from developmental pool, are wasted due to security threats which further declined

production in the country and speed up the wave of consumer inflation. Rising inflation in Pakistan is attributed to insufficient investment, lack of industrial estates, adverse shocks in supply, capital shortage and market imperfections, low foreign direct investment and population pressure etc.

II. Literature Review

Existing literature provides various determinants of rising terrorist incidents in developed as well as in developing economies of the globe. One school of thought by Gurr (1970) identified that poverty, income inequality and political violence are main determinants of terrorism while other school of thought lead by Tilly (1978) revealed that terrorism is increased due to rising violence and political opportunistic structure. Latter on, Muller and Seligson (1987) extended the models of Gurr (1970) and Tilly (1978) by incorporating income and land inequality and reported that high land inequality tends political violence that increases terrorists' activities. Similarly, London and Robinson (1989) explored that investment by multinational companies in developing economies have created high income inequality by generating more employment opportunities for skilled labor as compared to unskilled. This rising gap between haves and have-nots fuel violent behavior among the individuals and terrorism is increased.

Schock (1996) developed a hypothetical model by combining the economic discontent and political opportunistic framework. The empirical exercise indicated positive effect of economic inequality and separatist potential on political violence and hence on terrorism in weak regions. Blomberg et al. (2002) argued that terrorists' attacks may be instigated by groups, discontented with the economic instability but are unable to transform

political violence. Apart from that, Fearon and Laitin (2003) also reported that terrorism is directly affected by poverty, political instability, rough terrain and large populations. Li and Schaub (2004) investigated the effect of trade variables on terrorism and noted trade openness, foreign direct investment and portfolio investment are also responsible for increase terrorists' attacks. Bravo and Dias (2006) tested the impact of Islamism on violence and, found that Islamization does not have impact on terrorism. On other hand, they noted that disparity in low human development index is also sources of terrorists' attack in economies where human development is low. It implies that economic deprivation is responsible for increase in terrorism.

Some studies provided mixed empirical evidence on the relationship between repressive regimes or open democratic societies and terrorism [Li (2005), Kurrild-Kligaard et al. (2006) and Freytag et al. (2008)]. Li (2005) reported that the link between political freedom and terrorists' attacks is non-linear[3]. Similarly, Muller (1985) investigated the non-linear relationship between regime repressiveness and violence and found U-curve effect of regime repressiveness on terrorism if income inequality is controlled through trickle-down effect. Muller and Weede (1990) suggested that political violence is higher in transitional period of regime oppressiveness while Collier and Hoeffler (2001) concluded that rebellion is increased due to provision of opportunities. Krueger and Maleckova (2003) unveiled the effects of supply and demand framework using primary data collection from 1357 Palestinians. They found that high educated individuals are inclined to take part in terrorist activities due to their family backgrounds and their interest to partake in politics. Therefore more educated and well-off persons are more

interested to unite with Hezbollah. The demand-side hypothesis describes that terrorist organizations also prefer to recruit more educated persons with better skills. Similarly, Krueger (2008) confirmed the findings by Krueger and Maleckova (2003) by pointing out that educated individuals are happy to promote terrorist activities due to uneven distribution of economic growth.

Interestingly, Abadie (2004) tested the effect of economic variables on terrorists' attacks and found that terrorism is not much affected by economic variables while political freedom is significantly associated with terrorism[4]. Testas, (2004) investigated the impacts of macroeconomic variables on terrorism by collecting data of Muslim countries. Empirical evidence indicated that education is positively linked with terrorism. A rise in per capita income is linked with decline in terrorists' attacks while relationship between repression and terrorism is U-shaped and dummy for war is also responsible to increase terrorism. Apart from that, Piazza (2006) examined the effects of population, ethno-religious diversity and structure of party politics on political violence and noted that mentioned variables are determinants of terrorism[5].

There is an uninterrupted relationship between political violence and economic deprivation. For example, Li and Schaub, (2004) noted that economic deprivation increases terrorism. As Li (2005) concluded that economic growth through trickle-down effects and democracy through political freedom can control terrorist incidents. Similarly, Burgoon, (2006) suggested that spending on the well-being of people to alleviate penury, income disparity and economic uncertainty is helpful to condense terrorism. Kurrild-Klitgaard et al. (2006) identified that disparity in human development also promotes

terrorists' incidents. Apart from that, Bravo and Dias, (2006) pointed out that international trade is also responsible for rise in terrorism by increasing income inequality in more globalized regions of the world. Piazza (2008) examined the impact of democracy and state failures on domestic terrorism and reported that democracy and economic freedom do not have significant effect on terrorism while state failure is a strong predictor of domestic terrorism. Freytag et al. (2008) investigated the effect of socio-economic conditions on terrorism. They found positive impact of economic growth on terrorism while non-linear relation between economic growth and terrorism is inverted U-shaped. The negative correlation is found from investment to terrorism activities and education has inverse effect on political violence.

In case of Asian economies, Nasir et al. (2010) found that on the economic front, relative deprivation represented by income disparity is the major cause of terrorism. On the other hand, people deprived of their political rights and civil liberties, exhibited by political repression, compel them to be involved in terrorist activities. Furthermore, findings indicate that high literacy rate is one of the foremost reasons for terrorism. Moreover, relation between repression and terrorism is inverted U-shaped while inflation has positive impact on terrorism. In case of South African countries, Lisanti (2010) investigated the effect of social and political factors and found that no significant association is found between economic development and terrorism while relation between democracy and terrorist attacks is vague and, high level of terrorism is found in the states which are engaged with military conflicts.

In recent wave, Caruso and Schneider (2011) investigated the effects of socio-economic determinants of terrorism and political violence in West European countries[6]. Their results pointed out that economic growth, inflation and unemployment are inversely correlated with terrorism while youth unemployment is positively lined with terrorist activities. Moreover, trade openness and long tern interest rate decline political violence and hence terrorism and an increase in investment activities increase terrorism. Further, Piazza (2011) contributed in defence literature by investigating the effect of poverty and monitory economic discrimination on domestic terrorism. Author found that a rise in minority groups and economic discrimination increases domestic terrorism and are strong predictors of terrorism as compared to poverty and economic development. Richardson (2011) checked the validation of relative deprivation theory as well as absolute standard of deprivation. The results indicated that higher levels of unemployment as well as population size and education lead an increase in terrorism that validates the existence of relative deprivation while education alone dose not seem to effect terrorism.

The above discussion shows that only in two studies researchers investigated the effect of inflation (by taking an additional variable in their models) on terrorism and provided mixed results. Further, no consensus is found concerning causes of terrorism in Pakistan in terms of inflation and is main motivation for authors to fill the gap by investigating the impact of inflation on terrorists' attacks in presence of economic growth.

III. Modeling, Methodological Framework and Data Collection

The Model

The objective of the study is to investigate the effect of inflation on terrorist attacks in presence of economic growth. The growth variable is incorporated in the model to avoid the biasedness of results due to bivariate system. Economic theory i.e. *immiserizing modernization theory* indicates that economic growth can fuel terrorist activities if fruits of economic development could not be trickle-down to poor segments of population. The uneven economic growth raises income inequality and hence poverty[1]. High level of poverty lowers the opportunity cost for poor individuals. Such an environment favors the terrorist organizations to recruit poor individuals for terrorist incidents. This point is termed as economic deprivation by Gurr (1968). This shows that economic deprivation has positive effect on terrorism. On contrary, economic growth reduces political violence and hence terrorism if economic development declines income inequality and hence poverty by trickle-down effects.

We have transformed the series into natural-log form to avoid sharpness in the data. Another advantage of natural-log transformation is that it directly provides elasticities. The log-linear specification provides reliable empirical evidence which can be helpful to control terrorism by reducing inflation and economic deprivation. Following above discussion, algebraic equation for empirical purpose is modeled as follows:

$$\ln TER_t = \phi_1 + \phi_2 \ln INF_t + \phi_2 \ln GDP_t + \mu_t \qquad (1)$$

[1] For more details (see Olsen,1963)

Where, TER_t indicates the terrorist incidents, INF_t is inflation and GDP_t is for economic growth and μ_t is residual term assumed to be normally distributed.

ARDL Cointegration

To test long run association between inflation and terrorism in the presence of economic growth, ARDL bounds testing approach to cointegration developed by Pesaran and Pesaran (1997), Pesaran et al. (2000) and latter on by Pesaran et al. (2001) is applied. The bounds testing approach has numerous advantages over traditional techniques such as Engle-Granger (1987), Johansen and Juselies (1990) and Philips and Hansen, (1990). For instance, traditional approaches to cointegration require that variables to be used in the model must be integrated at unique order of integration. ARDL bounds testing approach to cointegration can be applied to investigate long run relation between the variables, if variables have mixed order of integration i.e. I(1) or I(0) or I(1)/ I(1). This approach is suitable for small sample data like in case of Pakistan to attain reliable results. Similarly, Laurenceson and Chai, (2003) pointed out that ARDL unrestricted model of ECM seems to take satisfactory lags that captures the data generating process in a general-to-specific framework of specification. Moreover, a dynamic error correction model (ECM) can be derived from the ARDL model through a simple linear transformation (Banerrjee and Newman, 1993). The error correction model integrates the short-run dynamics with the long-run equilibrium without losing information about long-run. The ARDL bounds testing approach to cointegration involves the unrestricted error correction method (UECM) of the ARDL model as follows:

$$\Delta \ln TER_t = \alpha_\circ + \alpha_T T + \alpha_{TER} \ln TER_{t-1} + \alpha_{INF} \ln INF_{t-1} + \alpha_{GDP} \ln GDP_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln TER_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln INF_{t-j} + \sum_{l=0}^{m} \alpha_k \Delta \ln GDP_{t-l} + \mu_i \quad (2)$$

$$\Delta \ln INF_t = \beta_\circ + \beta_T T + \beta_{TER} \ln TER_{t-1} + \beta_{INF} \ln INF_{t-1} + \beta_{GDP} \ln GDP_{t-1} + \sum_{j=0}^{p} \beta_j \Delta \ln INF_{t-j} + \sum_{l=0}^{q} \beta_k \Delta \ln TER_{t-l} + \sum_{n=0}^{m} \beta_l \Delta \ln GDP_{t-n} + \mu_i \quad (3)$$

$$\Delta \ln GDP_t = \phi_\circ + \phi_T T + \phi_{TER} \ln TER_{t-1} + \phi_{INF} \ln INF_{t-1} + \phi_{GDP} \ln GDP_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \ln GDP_{t-i} + \sum_{j=0}^{q} \phi_j \Delta \ln INF_{t-j} + \sum_{l=0}^{m} \phi_k \Delta \ln TER_{t-l} + \mu_i \quad (4)$$

The intercept and time trend components are shown by $\alpha_\circ, \beta_\circ, \phi_\circ$ and $\alpha_T, \beta_T, \phi_T$ respectively. The next step is to estimate the F-statistic to compare it with tabulated critical values by Pesaran et al. (2001) to check whether cointegration exist or not. The null hypothesis of no cointegration in three models is $\alpha_{TER} = \alpha_{INF} = \alpha_{GDP} = 0$, $\beta_{TER} = \beta_{INF} = \alpha_{GDP} = 0$ and $\phi_{TER} = \phi_{INF} = \phi_{GDP} = 0$. The hypothesis of cointegration can be test by hypothesis i.e. $\alpha_{TER} \neq \alpha_{INF} \neq \alpha_{GDP} \neq 0$, $\beta_{TER} \neq \beta_{INF} \neq \beta_{GDP} \neq 0$ and $\phi_{TER} \neq \phi_{INF} \neq \phi_{GDP} \neq 0$. The decision is in favor of cointegration between the variables if calculated F-statistic is more than upper critical bound (UCB). We accept the hypothesis of no cointegration if lower critical bound (LCB) exceeds the calculated F-statistic. Finally, if calculated F-statistic lies between lower and upper critical bounds then decision about cointegration is inconclusive. The stability test is also conducted by employing the cumulative sum of recursive residuals (**CUSUM**) and the cumulative sum

of squares of recursive residuals (**CUSUMsq**) to test the stability of long-and-short runs estimates.

VECM Granger Causality

The confirmation of cointegration between the variables leads us to investigate the direction of Granger-causality between the variables. The Granger representation theorem suggests that there will be Granger causality in at least one direction if there exists cointegration relationship between the variables, provided that the variables are integrated of order one or I(1). Engle-Granger (1987) cautioned that if the Granger causality test is conducted at first difference through vector auto regression (VAR) method then it will be misleading in the presence of cointegration. Therefore, the inclusion of an additional variable to the VAR method such as the error correction term would help us to capture the long-run relationship. To this end, error correction term is involved in the augmented version of Granger causality test and it is formulated in a bi-variate *p*th order vector error-correction model (VECM) which is as follows:

$$\begin{bmatrix} \Delta \ln TER_t \\ \Delta \ln INF_t \\ \Delta \ln GDP_t \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} + \begin{bmatrix} B_{11,1} B_{12,1} B_{13,1} \\ B_{21,1} B_{22,1} B_{23,1} \\ B_{31,1} B_{32,1} B_{33,1} \end{bmatrix} \times \begin{bmatrix} \Delta \ln TER_{t-1} \\ \Delta \ln INF_{t-1} \\ \Delta \ln GDP_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} B_{11,m} B_{12,m} B_{13,m} \\ B_{21,m} B_{22,m} B_{23,m} \\ B_{31,m} B_{32,m} B_{33,m} \end{bmatrix} \times \begin{bmatrix} \Delta \ln TER_{t-1} \\ \Delta \ln INF_{t-1} \\ \Delta \ln GDP_{t-1} \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_3 \\ \zeta_3 \end{bmatrix} \times (ECM_{t-1}) + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \quad (5)$$

In this framework, difference operator is Δ while m indicates appropriate and optimal lag length following Akaike information criteria (AIC). ECM_{t-1} is lagged residual term

obtained from long run cointegration empirical equations[2]. The residual terms are μ_{1t}, μ_{2t} and μ_{3t} normally distributed having zero mean and predetermined covariance matrix. The VECM analysis provides three sources of causation if variables are found to be cointegrated such as (a) short run Granger-causality, (b) long run Granger-causality and joint long-and-short runs (overall) Granger-Causality. This is the main advantage of using VECM multivariate framework. The joint χ^2-statistic is used on the 1st difference lagged independent variables to test the direction of short run Granger-causality between the variables. $B_{12,m} \neq 0$ and $B_{13,m} \neq 0$, $B_{21,m} \neq 0$ and $B_{23,m} \neq 0$ and $B_{31,m} \neq 0$ and $B_{32,m} \neq 0$ indicate that Granger causality is running from inflation and economic growth to terrorism, from terrorism and economic growth to inflation and, from terrorism and inflation to economic growth respectively. The long run Granger causality is tested by t-statistic of ECM_{t-1} with negative sign. The short-and-long runs Granger causality is investigated by the significance of joint χ^2-statistic on lagged residual term and 1st difference lagged concerned independent variables. For instance, $\zeta_1 \neq 0, \beta_{12,m} \neq 0$ shows that long-and-short runs Granger causality is running from inflation to terrorism and vice versa. Same inferences can be drawn from other outcomes.

The data on annual inflation (INF_t) and real GDP per capita (GDP_t) is collected from GoP (2010). The South Asia Terrorism Portal (SATP) is use to obtain data on terrorist incidents (TER_t). The time span of the study starts from 1971-2010.

[2] If variables are not cointegrated then ECM_{t-1} is not included in the model to be estimated for Granger causality.

IV. Findings and Discussions

The descriptive statistics and pair-wise correlations are reported in Table-1. It is found that series of inflation, terrorist attacks and economic growth are normally distributed. The results describe that there is positive pair-wise correlation from inflation and economic growth to terrorism and negative correlation is found between inflation and economic growth.

Table-1: Descriptive Statistics and Correlations

Variables	$\ln TER_t$	$\ln INF_t$	$\ln GDP_t$
Mean	4.0189	2.1086	10.0378
Median	4.1743	2.1122	10.1130
Maximum	6.2499	3.2832	10.4477
Minimum	1.0986	1.0695	9.5491
Std. Dev.	1.3312	0.5458	0.2795
Skewness	-0.2801	0.0756	-0.3491
Kurtosis	2.3406	2.6154	1.8776
Jarque-Bera	1.2164	0.2774	2.8394
Probability	0.5443	0.8704	0.2417
$\ln TER_t$	1.0000		
$\ln INF_t$	0.0885	1.0000	
$\ln GDP_t$	0.8305	-0.1504	1.0000

Before proceeding to ARDL bounds testing approach to investigate long run cointegration between inflation, terrorism and economic growth, it is necessary to find out integrating order of the series. ARDL cointegration approach can be applicable if variables are integrated at I(0) or I(1) or I(0) / I(1) i.e. mixed order of integration. The main assumption of ARDL bounds testing approach to cointegration is that variables must be stationary at level or at 1st difference if any variable in integrated at I(2) then computation of F-statistic becomes invalid to take decision about the existence of long run relationship. In doing so, we have applied three unit root tests i.e. ADF by Dickey and Fuller (1979), DF-GLS by Elliot et al. (1996) and Ng-Perron by Ng and Perron (2001) to ensure that no variable is integrated at I(2)[3]. The results indicate that series have unit root problem at level and found to be integrated at I(1). Baum (2004) argued that ADF, DF-GLS and Ng-Perron unit root tests provide biased results. The main reason is that these unit root tests do not have information about structural breaks occurring in the series.

We have chosen two structural break unit tests to overcome this problem i.e. Clemente-Montanes-Reyes (1998) de-trended and Zivot-Andrews (1992) trended structural break unit root tests and results are reported in Table-2. The main advantage of Clemente-Montanes-Reyes unit root test is that it has information about two possible structural break points in the series by offering two models i.e. an additive outliers (AO) model informs about a sudden change in the mean of a series and an innovational outliers (IO) model indicates about the gradual shift in the mean of the series.

[3] Results are not reported but available from authors upon request.

Table-2: Clemente-Montanes-Reyes Detrended Structural Break Unit Root Test

Variable	Innovative Outliers				Additive Outlier			
	t-statistic	TB1	TB2	Decision	t-statistic	TB1	TB2	Decision
$\ln TER_t$	-5.339	1983	2005	I(0)	-6.451*	1993	2003	I(1)
$\ln INF_t$	-3.049	1989	1999	I(0)	-8.037*	1995	2001	I(1)
$LGDP_t$	-2.150	1984	1993	I(0)	-6.149*	1990	2003	I(1)
Note: * indicates significant at 1% level of significance.								

Table-3: Zivot-Andrews Structural Break Trended Unit Root Test

Variable	**At Level**		**At 1st Difference**	
	T-statistic	Time Break	T-statistic	Time Break
$\ln TER_t$	-5.084 (0)***	1986	-6.296(2)*	1991
$\ln INF_t$	-4.089(0)	1999	-7.809 (0)*	2004
$LGDP_t$	-3.361(1)	1993	-5.645(0)*	1993
Note: * and *** represent significant at 1%, and 10% level of significance. Lag order is shown in parenthesis.				

The additive outlier model is more suitable for the variables having sudden structural changes as compared to gradual shifts. The results by Clemente et al. (1998) unit root test show that inflation, terrorist attacks and economic growth have unit root problem at their level form while variables have become stationary at 1st difference i.e. integrated at I(1). We prefer Clemente et al. (1998) unit root to make the base of results. The robustness of stationarity properties of inflation, terrorist attacks and economic growth in investigated

by Zivot-Andrews (1992) unit root test having information about one structural break exists in the series. The results reported in Table-3 show that variable have unique order of integration except terrorist attacks.

Table-4: Lag Order Selection

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-61.64929	NA	0.007285	3.591627	3.723587	3.637685
1	46.44947	192.1756	2.97e-05	-1.913859	-1.386020*	-1.729629
2	58.30656	19.10309*	2.56e-05*	-2.072587*	-1.148867	-1.750184*
3	63.35484	7.291968	3.29e-05	-1.853047	-0.533448	-1.392471

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The uniqueness in order of integration confirmed by Clemente-Montanes-Reyes (1998) unit root test leads us to investigate the long run relationship between the series by applying ARDL bounds testing approach to cointegration. To apply ARDL bounds, selection of appropriate lag length is necessary. It is pointed out that F-statistic is very much sensitive with lag order of the variables (Feridun and Shahbaz, 2010). Table-4 reveals that we cannot take lag order more than 2 in case of Pakistani data.

The results of ARDL bounds testing are pasted in Table-5. The calculated F-statistics are 8.775 and 5.030 greater than upper critical bounds at 5% and 10% level of significance when terrorist attacks and inflation are used as dependent variables. We have used critical bounds generated by Turner (2006). The critical bounds developed by Pesaran et al. (2001) and Narayan (2005) are not suitable for small sample data as in this case. Our analysis concludes that there are two cointegrating vectors which validate the existence of long run relationship between inflation, terrorism and economic growth in case of Pakistan for period of 1971-2010.

Table-5: Cointegration Test: Bounds Test

Panel I: Bounds testing to cointegration			
Estimated Models	$F_{TER}(TER/INF,GDP)$	$F_{GDP}(GDP/TER,INF)$	$F_{INF}(INF/TER,GDP)$
Optimal lag structure	(1, 2, 1)	(2, 2, 1)	(1, 1, 2)
F-statistics	8.775**	4.754	5.930***
Significant level	Critical values (T = 39)[#]		
	Lower bounds $I(0)$	Upper bounds $I(1)$	
1 per cent level	7.397	8.926	
5 per cent level	5.296	6.504	
10 per cent level	4.401	5.462	
Panel II: Diagnostic tests	Statistics	Statistics	Statistics
R^2	0.6913	0.6745	0.4865
Adjusted- R^2	0.5498	0.4141	0.1542

J-B Normality test	1.0096 (0.6036)	1.2701 (0.5298)	0.1739 (0.9166)
Breusch-Godfrey LM test	0.3887 (0.6824)	2.2894 (0.1407)	0.2156 (0.8085)
ARCH LM test	2.1822 (0.1298)	0.5225 (0.4765)	0.4781 (0.4954)
W. Heteroskedasticity Test	0.8585 (0.5888)	0.5887 (0.8019)	1.6329 (0.1760)
Ramsey RESET	1.2371 (0.2775)	0.0984 (0.7583)	1.1041 (0.3090)

Note: The lag selection is based on AIC and SBC. ** and *** denotes the probability and the significant level at 5% and 10% respectively.

Table-6: Results of Test of Cointegration

Hypothesis	Trace Test Statistic	5% CV	Hypothesis	Maximum Eigen Value	5%CV
R = 0	50.9761*	35.1927	*R = 0*	25.0097**	22.2996
R ≤1	25.9664*	20.2618	*R = 1*	18.7049**	15.892
R ≤2	7.2614	9.1645	*R = 2*	7.2614	9.1645

Unit root analysis indicate that all series i.e. inflation, terrorist attacks and economic growth are integrated at I(1). This unique level of integration also leads us to use Johansen multivariate approach to cointegration for robustness of long run relationship. The findings show that there are two cointegration vectors between inflation, terrorism and economic growth in case of Pakistan for the period of 1971-2010 which confirm the robustness of long run relation.

This study also applies rolling window bounds testing approach to cointegration to probe whether a cointegrating relation is stable or not. The theoretical and empirical literature was not given any confirmation to choose the rolling windows size. In order to capture

static and dynamic association between inflation, economic growth and terrorism, we take 13-years observations as a window size. Thus if the normalize F statistic is greater than one then cointegration exists and stable. Our results for rolling window approach to ARDL cointegration show that moving window size is 13 and ARDL model with 2 lags is estimated for $TER = f(INF, GDP)$, $INF = f(TER, GDP)$ and $GDP = f(TER, INF)$ with unrestricted intercept and unrestricted trend. The upper critical bound from Pesaran et al. (2001) is 4.535 with k-1 (regressor) having constant with trend. The selection of the window size of 13-years is appropriate to justify that static and vibrant link between inflation and terrorism can be checked. The normalised F-statistic of $TER = f(INF, GDP)$, $INF = f(TER, GDP)$ and $GDP = f(TER, INF)$ for each window can be visualized by the thick and straight line mentioned in Figure-2, 3 and 4. It is stated that if the normalized F-statistic is more than 1 (more than thick and straight line) then there is stable cointegration between the variables. The descriptive view of normalized F-statistic of equation-2 is reported in Table-6. It is noted that cointegration relation between inflation, economic growth and terrorism is instable before 1998 and after 1998, there is stable long run relationship is found between the variables in case of Pakistan when inflation and economic growth are used as forcing variables.

The Plot of Normalized F-statistic for Rolling Windows Bounds Test

Figure-1: Graph of $TER = f(INF, GDP)$

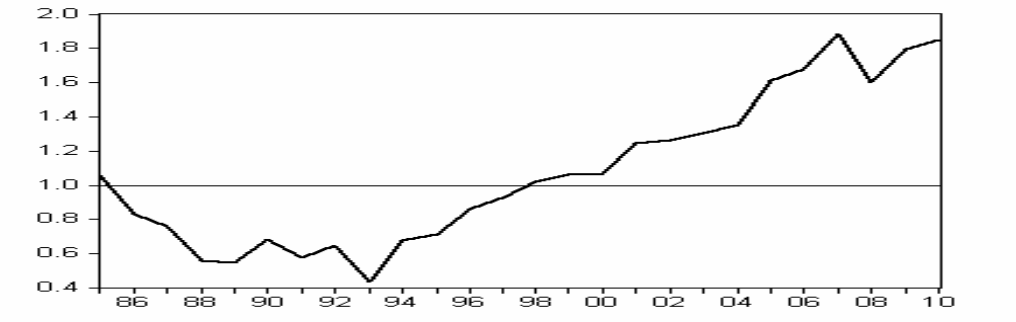


Figure-2: Graph of $INF = f(TER, GDP)$

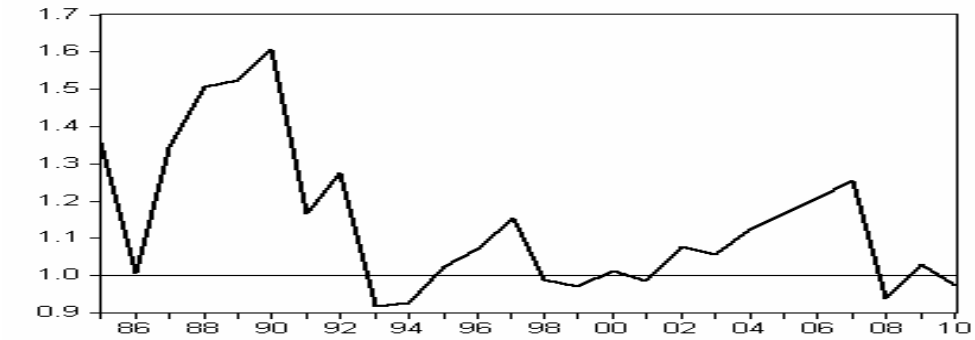


Figure-2: Graph of $GDP = f(INF, TER)$

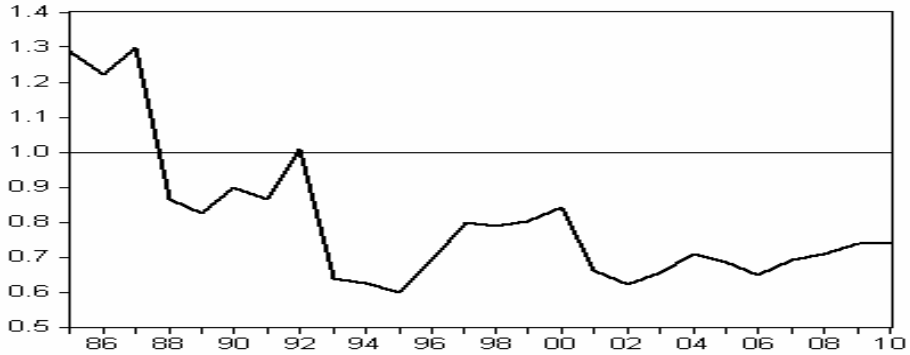


Figure-2 indicates that cointegration between inflation, economic growth and terrorism is instable in 1993-94, 1998-2001 and 2008-10 and rest period shows the existence of long run relation between the variables when inflation is considered as dependent variable. There is no existence of stable cointegration when inflation and terrorism are appointed

as forcing variables. Table-7 reveals the descriptive view of rolling window ARDL bounds testing approach to cointegration which indicates that more than 1 normalized F-statistic is 53.84% while less than 1 is 46.16.75% in terrorism equation i.e. $TER = f(INF, GDP)$ which indicates overall stable long run association between the variables. In inflation equation i.e. $INF = f(TER, GDP)$, normalized F-statistic is 73% and 27% is found for more than 1 and less than 1, provides strong support for the existence of cointegration. Growth equation i.e. $GDP = f(INF, TER)$ indicates high proportion of F-statistic is less than 1 revealing no cointegration between the variables. This exercise shows that long run results are robust.

Table-7: Normalised F-Statistics

	Dependent Variable	
	TER_t	
Less than 1	12	46.16%
More than 1	14	53.84%
Total	26	100%
	INF_t	
Less than 1	7	27%
More than 1	19	73%
Total	26	100%
	GDP_t	
Less than 1	22	84.62%
More than 1	4	15.38%
Total	26	100%

The regression results in Table-8 indicate positive affect of inflation on terrorism or terrorist attacks. It is noted that a 1 percent increase in inflation raises 0.52 percent terrorism and it is significant at 5 percent significance level. It is reported above that rising inflation reduces the purchasing power and increases poverty. Under such circumstance, the opportunity cost of life reduces and makes terrorism a plausible course

of action for the poor to achieve financial resources to maintain their life. In fact many will tradeoff their own lives to generate financial resources for the bereaved. This results an increase in terrorism. Rising terrorist activities have declined foreign direct investment in Pakistan. FDI has been declined to $ 910.20 million from $ 1.4 billion in 2008-09. This decline in foreign direct investment increased unemployment and poverty in the country. Terrorism promoted the smuggling, shattered the trust of investors, affected financial markets and increased military spending to fight against it.

Surprisingly, the effect of economic growth is positive and statistically significant at 1% level of significance. These findings are contradictory with Nasir et al. (2010) while consistent with Caruso and Schneider (2011). Further, results show that a 1 percent increase in economic growth will raise terrorist attacks by 4.112 percent. This indicates that distribution of income in Pakistan is deteriorating day-by-day and increasing income inequality. This gap between "haves and haves not" in the country is linked with rise in poverty and hence with terrorism. This finding is contradictory with Nasir et al. (2010) who reported that an increase in income per capita is linked with decline in terrorism in South Asian countries while Muller and Seligson, (1987) argued that economic growth increases terrorism when economic growth does not benefit poor segments of population through trickle-down effect.

Table-8: Long Run Results

Dependent Variable: $\ln TER_t$				
Variable	Coefficient	T-Statistic	Coefficient	T-Statistic
Constant	-38.3824	-9.0780*	-46.3516	-0.2035
$\ln INF_t$	0.5327	2.5246**	0.5369	1.9845***
$\ln GDP_t$	4.1122	9.9786*	5.7059	0.1260
$\ln GDP_t^2$	…	…	-0.0797	-0.0353
Diagnostic Test				
R^2	0.7365			
$Adj - R^2$	0.7219			
F-statistic	50.3216*			
$\chi^2 NORMAL$	0.6319	0.7290	0.6273	0.7307
$\chi^2 SERIAL$	0.4886	0.6176	0.4704	0.6288
$\chi^2 ARCH$	1.7961	0.1813	1.7677	0.1860
$\chi^2 WHITE$	2.4087	0.1040	1.6047	0.2058
$\chi^2 REMSAY$	0.0007	0.9782	0.0022	0.9625

We also conducted several diagnostic tests to exhibit any evidence of violation of the classical linear regression model assumptions. The Jarque-Bera (J-B) normality test cannot reject the null hypothesis which implies that the estimated residuals are normality distributed and thus, the standard statistical inferences (i.e., t-statistic, F-statistic and R-squares) are valid. Both Breusch-Godfrey LM test and ARCH LM test consistently reveal

that the residuals are not serially correlated and also free from heteroskedasticity problem. Functional form of model is well specified.

Table-9: Short Run Results

Dependent Variable: $\Delta \ln TER_t$			
Variable	Coefficient	Std. Error	T-Statistic
Constant	-0.0846	0.1657	-0.5105
$\Delta \ln INF_t$	0.6852	0.3031	2.2607**
$\Delta \ln GDP_t$	5.8332	5.5972	1.0421
ECM_{t-1}	-0.8229	0.0860	-9.5589*
R^2			
$Adj - R^2$			
F-statistic			

Short Run Diagnostic Tests		
Test	Statistic	Prob. value
Jarque-Bera Normality Test	1.0027	0.6056
Serial Correlation LM Test	0.8225	0.4487
ARCH Test	2.0975	0.1393
Heteroskedasticity Test	1.2732	0.2996
Ramsey RESET Test	1.7119	0.2001

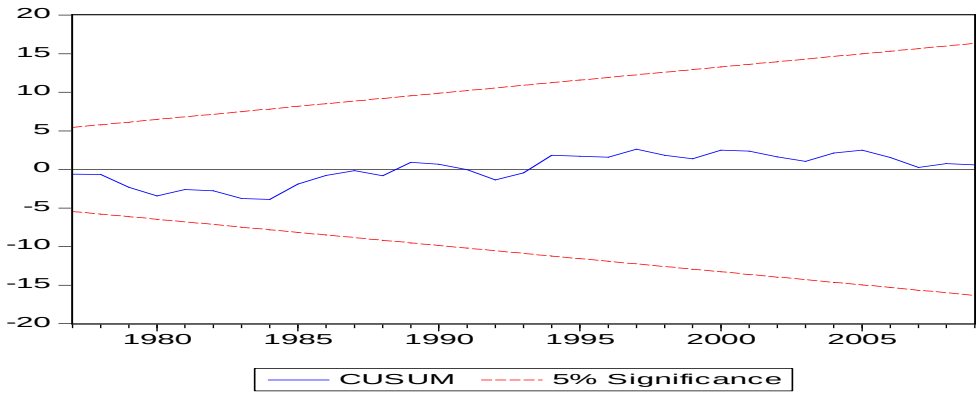
Table-9 is related to short run behaviour of forcing variables on regressand. It is noted that the ECM is between 0 and –1 and is statistically significant at the 1% significance level. This implies that, the error correction process converges monotonically to the equilibrium path relatively quickly. The coefficient of lagged error term is equal to -0.8229 and its significance confirms the established cointegration relation between the variables. Further, it also implies that a deviation from the equilibrium level of TER_t during the current period will be corrected by 96.87% in the future. In short run, terrorism is positively affected by rising inflation. It is opined on the basis of our results that a 1% increase in terrorism is linked with an increase in inflation by 0.68% and it is significant at 5% significance level. The effect of economic growth on terrorism in positive but it is statistically insignificant.

The diagnostic tests such as LM test for serial correlation, normality of residual term, white heteroscedisticity and model specification have been conducted. The results are reported in lower part of Table-9. The empirical findings show that short-run model seems to pass all diagnostic tests successfully. It is noted that residual term is normally distributed. There is no evidence of serial correlation and autoregressive conditional heteroscedisticity. Furthermore, problem of white heteroscedisticity is not found and estimates of Ramsey Reset test indicate that functional form of model is not misspecified.

The stability tests have been used to investigate the stability of long and short run parameters. In doing so, cumulative sum (**CUSUM**) and cumulative sum of squares (**CUSUMsq**) tests have been conducted.

Figure **3**

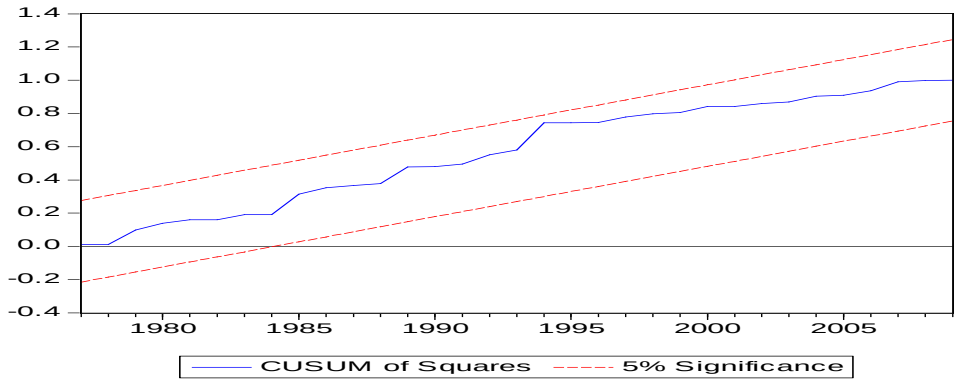
Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure **4**

Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Pesaran and Shin, (1999) have suggested to estimate the stability of long and short run estimate through CUSUM and CUSUMsq tests. The graphs of both **CUSUM** and **CUSUMsq** are presented above (see figure 3 and 4**)**. The figure 3 and 4 specify that plots for both **CUSUM** and **CUSUMsq** are between critical boundaries at 5 % level of significance. This confirms the accuracy of long and short run parameters which have effect on terrorism in case of Pakistan. Moreover, both tests also verify the stability of

ARDL model for structural stability i.e. there is no structural break. This indicates that model seems to steady and specified appropriately.

After finding long-and-short runs' effect of inflation and economic growth on terrorism, next step is to investigate the direction of causal relation between the said variables. The detection of causality between the variable would help policy makers to control terrorism by declining inflation in the country. The application of ARDL bounds testing approach does suggest us about the direction of causality except cointegration. As Morley (2006) pointed that existence of long run association between the variables is considered as necessary but not sufficient condition to reject the non-causality hypothesis.

Our empirical results reported in Table-2 indicated bidirectional causality between inflation and terrorism in long-and-short runs. This reveals that rising inflation reduces purchasing power of poor segments of population especially and rising terrorism shatters the trust of investors (both local and foreigner) and declines production level in the country while demand is rising day-by-day due to an increase in population and in resulting inflation is increased. The unidirectional Granger-causality is found running from economic growth to terrorism and consistent with Gries et al. (2011) who reported that economic growth leads the terrorist violence. Economic growth seems to Granger-cause inflation to decline in long run by production-enhancing effect. The unidirectional short run causality is found running from terrorism to economic growth in short run.

Table-10: VECM Granger Causality Analysis

Dependent variable	Type of Granger causality						
	Short-run			Long-run	Joint (short- and long-run)		
	$\Delta \ln TER_t$	$\Delta \ln INF_t$	$\Delta \ln GDP_t$	ECM_{t-1}	$\Delta \ln TER_t, ECM_{t-1}$	$\Delta \ln INF_t, ECM_{t-1}$	$\Delta \ln GDP_t, ECM_{t-1}$
	F-statistics [p-values]			[t-statistics]	F-statistics [p-values]		
$\Delta \ln TER_t$	–	4.2813** [0.0231]	1.5532 [0.2281]	–1.0278* [–4.7606]	–	9.3074* [0.0002]	8.6365* [0.0003]
$\Delta \ln INF_t$	6.7320* [0.0038]	–	0.0722 [0.9304]	–0.4087* [–2.9426]	5.2489* [0.0050]	–	5.8139* [0.0030]
$\Delta \ln GDP_t$	2.5727*** [0.0931]	0.3171 [0.7307]	–	–0.0033 [-0.1007]	1.9948 [0.1360]	0.2235 [0.8793]	–

It is argued by Wolde-Rufael, (2009) that Granger causality tests do not seem to determine the relative strength of causality effects beyond the selected time span. In such circumstances, causality tests are inappropriate because these tests are unable to indicate that how much feed back is existed from one variable to other. To examine the feedback from one variable to another and to check the relative effectiveness of causality affects ahead of sample period. We have applied Variance Decomposition approach to examine direction of causality between inflation, terrorism and economic growth following Wolde-Rufael, (2009). It is noted that variance decomposition is applied to investigate the response of the dependent variable to shocks stemming from independent variables. Variance decomposition method is an alternate of impulse response function. This process explains how much of the predicted error variance for any variable is described by innovations generated throughout each independent variable in a system over various time-horizons.

The results are shown in Table-11 suggest that terrorism is explained 79.60% by its own innovative shocks while inflation and economic growth explain terrorism by 12.75% and 7.64% through their innovative shocks. Inflation is explained 12.17% by terrorism and 5.04% by economic growth and 82.78% portion is by innovations of inflation. This shows that contribution of economic growth to explain inflation is minimal. Finally, a 33.39% portion is explained through innovative shocks of economic growth while inflation contributes to economic growth by 23.58% and terrorism explains economic growth 41.67% through their shocks.

Table-11: Variance Decomposition

Variance Decomposition of $\ln TER_t$				
Period	S.E.	$\ln TER_t$	$\ln INF_t$	$\ln GDP_t$
1	0.7584	100.0000	0.0000	0.0000
3	0.8288	85.2188	8.1661	6.6150
4	0.8531	83.3255	8.5510	8.1234
5	0.8573	83.2468	8.5998	8.1532
7	0.8775	82.9392	9.0123	8.0484
8	0.8952	81.2116	11.0403	7.7480
9	0.8998	80.4386	11.8763	7.6850
11	0.9057	80.0278	12.3844	7.5877
12	0.9079	79.7649	12.6678	7.5671
13	0.9084	79.6747	12.7516	7.5736
14	0.9089	79.6311	12.7639	7.6048
15	0.9096	79.6011	12.7581	7.6407
Variance Decomposition of $\ln INF_t$				
Period	S.E.	$\ln TER_t$	$\ln INF_t$	$\ln GDP_t$
1	0.4159	11.5191	88.4808	0.0000
3	0.5346	10.3270	87.4369	2.2360
4	0.5553	10.8974	85.0970	4.0055
5	0.5754	10.1577	85.1978	4.6444
7	0.5864	11.3575	83.5985	5.0438
8	0.5872	11.5090	83.4560	5.0349
9	0.5881	11.7679	83.2089	5.0230
11	0.5904	12.1860	82.7950	5.0188
12	0.5906	12.1753	82.7923	5.0323
13	0.5907	12.1743	82.7878	5.0377
14	0.5907	12.1755	82.7866	5.0378
15	0.5907	12.1781	82.7840	5.0378
Variance Decomposition of $\ln GDP_t$				
Period	S.E.	$\ln TER_t$	$\ln INF_t$	$\ln GDP_t$
1	0.0156	3.1175	11.4903	85.3920
3	0.0278	2.9753	25.2783	71.7463
4	0.0323	10.0792	21.9269	67.9938
5	0.0366	20.4148	17.3500	62.2351
7	0.0435	32.7672	16.9737	50.2590
8	0.0467	37.1789	18.0652	44.7557
9	0.0496	39.5317	19.9761	40.4920
11	0.0534	41.1372	22.9137	35.9489
12	0.0547	41.6732	23.5865	34.7402
13	0.0557	42.0008	24.0752	33.9239
14	0.0565	42.1987	24.4054	33.3957

15	0.0573	42.4023	24.5750	33.0226

The overall conclusion from results is that bidirectional causality between inflation and terrorism is confirmed as established by VECM Ganger-causality approach. It implies that results are robust. Economic growth is Granger-caused by terrorism and inflation. This result is contradictory with VECM findings may be due to different back grounds of both approaches.

Conclusion and Policy Implications

Terrorism is a very sensitive issue in Pakistan. Economic literature highlights various factors affecting terrorism. Terrorism hits the economy directly and indirectly by declining FDI, shattering the trust of local investors, affecting financial markets, lowering economic growth, rising unemployment and poverty. The present paper examined the effect of inflation and economic growth on terrorism which is ignored in defence literature in case of Pakistan.

For this purpose, ARDL bounds testing approach and rolling window to cointegration have been applied. Order of integration of the variables is checked by employing ADF, ADF-GLS, Ng-Perron and Zivot and Andrews unit root tests. The direction of causality has been investigated by applying VECM Granger causality. The results show cointegration between inflation, economic growth and terrorism and the relationship is robust. Inflation raises terrorism while economic growth is also major contributor to terrorist attacks in the country. Bidirectional causal relation is found between inflation and terrorism while terrorism leads economic growth in the short run.

In the context of policy implication, government must take immediate initiatives to control inflation to save the economy from adverse effects of terrorism. Additionally, government should enhance employment opportunities in deprived regions of the country such FATA and Khyber Pukhtunkhawa (old NWFP) by encouraging investment activities. Fruits of economic growth must be trickled down to bottom segments of population. Rising corruption must be controlled through transparent accountability system. Proper implementation of macroeconomic policies should be ensured. Government should establish institutions which are responsible for employment opportunities, access to education, health facilities and to build goodwill between government and people.

For further research, ignored variables such as democracy following Piazza (2008), unemployment (old and youth) by Richardson (2011), minority and regional economic disparity by Piazza (2011), financial and trade openness by Nitsch and Schumacher (2004) can be incorporated to examine the effect of proposed factors on terrorism. This can be more helpful for policy makers to formulate more comprehensive defence policy to control terrorism from its root causes in case of Pakistan.

Footnotes

1. Bjørgo (2005) has also claimed that persistent level of poverty is also major reason of rising terrorist activities.
2. Although there are many reasons of terrorist activities but it is also one of them ignored in defence literature.
3. Hamilton and Hamilton (1983) noted that illiterate, poor, democratic and open societies are correlated with high terrorism.
4. Abadie (2004) could not find any significant effect of economic development on terrorism.
5. The hypothesis that countries which are most populated tend to generate more terrorism is validated by Krueger and Maleckova (2003), Burgoon (2006), Lai (2007), Plumper and Neumayer (2007), Freytag et al. (2008) and Piazza, (2008).
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