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DO NATURAL DISASTERS CAUSE ECONOMIC GROWTH? AN ARDL BOUND TESTING APPROACH

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Abstract:

This article strives to work out the causal relationship between natural disasters and economic growth in Pakistan. The study empirically tests the linkage using econometric techniques autoregressive distributed lag bound model by Pesaran (2001) and Granger causality test. We develop a proxy for the loss of natural disasters by a similar method as Noy (2009) and Bergholt et.al, (2012) did. The results of ARDL bounds testing approach evidence a negative long run relationship between the proxies of natural disasters and economic growth. The results of Granger Causality depict the uni-directional causality from natural disasters to economic growth both in short-run and long-run. Overall, the study determines that natural disasters deteriorate economic growth in Pakistan. This is the first study in Pakistan to assess the causal relationship among natural disasters and economic growth. So, further empirical evidence may link natural disasters to microeconomics and financial indicators. In future, researchers might control the impact of foreign development aid, remittances, political stability and country's corruption rating. Natural disasters are an alarming issue and, addressing the questions related to their impacts on welfare of human being and economic growth of the countries contain significant importance in order to attract the attention of global development agencies and policymakers. As per INFORM (2015) risk index, Pakistan has the highest vulnerability towards natural disasters after Afghanistan. So, the study contains more significant value in context of Pakistan.

Key words: *Pakistan, Natural Disasters, Economic Growth, ARDL Bound*

1. Introduction

According to a report by World Bank 2000/2001, developing nations have always been greatly influenced and affected by natural disasters. Having a high magnitude and quantity of natural disasters, developing nations suffered from a huge number of deaths. In its report, the World Bank has documented that world has faced 568 natural disasters during the period of 1990-1998 consisting of 94% of the whole world's disasters out of which 97% of the damage has been done in developing nations(, 2000/2001, World Development Report: Attacking Poverty). Another example is the year 1999 in which approximately 100 billion dollars of economic loss and more than 105,000 deaths have been reported and, as usual developing nations carried approximately 2/3 of the total economic loss and 95% of the total deaths (Kunreuther, 2001).

Natural disasters are an alarming issue and, addressing the questions related to their impacts on welfare of human being and economic growth of the countries contain significant importance in order to attract the attention of global development agencies and policymakers. Moreover, global warming has been increasing at a fast pace and more likely to severely affect the nations and their economies (IPCC, 2007). Due to a significant increase in natural disasters since the recent couple of decades, it has exposed the countries towards an unpredictable potential risk (ProVention Consortium, 2001). As Munich Re (A large reinsurance company) has reported that: "After correction for increased population, wealth and inflation, economic losses due to natural disasters increased twofold from 1970 to 2000 (Best's Review, 2000)".

Given its significant importance we can find scant evidence on the causal relationship between natural disasters and economic growth by using econometric techniques. As per our info, we cannot find any single study in Pakistan that cracks the causal relationship among natural disasters and economic growth. The current paper inspects the basis research question: How natural disasters containing storms, earthquakes, floods, rise in temperature and cyclones link to economic growth of Pakistan?

This study differentiates from earlier studies on natural disasters-economic growth nexus in numerous aspects: First, most of the previous work took into account the economic effects of large scale natural disasters only, while this study also includes the disasters on a small scale in the analysis as disasters on small scale may also have a relationship with economic growth both in short-run and long-run. Secondly, previous studies use the traditional techniques of co-integration to check the long run relationship accompanying Engle and Granger (1987) causality test and, the maximum likelihood test based upon the Johnson & Juselius (1990). But according to Narayan (2005), these traditional cointegration techniques may not be suitable for too small sample sizes. Finally, majority of the studies use the cross sectional data to inspect the causal link between natural disasters and economic growth across counties which may lead towards potential bias and inconsistent estimates (see also Odhiambo, 2008; Caselli et al. 1996; Ghirmay, 2004). In cross sectional data analysis, a serious drawback is to make groups of countries having different levels of economic development which tends to generalize the natural disasters-economic growth causal relationship. In this context, the current study tries to estimate the temporal causal nexus using autoregressive distributed lag bounds testing approach.

The paper attempts to achieve its objective in the following chronological order: We begin by talking about the natural disasters in Pakistan, brief review of related literature and, on the base of literature hypothesis is developed. Before turning to the discussion and interpretation of our analysis, we explain the quantification of variables, empirical model specification, and econometrics analysis techniques. Finally, the whole study is concluded based upon our main results and their implications.

2. Natural Disasters in Pakistan

After the Pakistan independence in 1947, its climate condition has changed considerably because of industrialization consequently, acceleration in GHG emissions has taken place. However, this situation of climate change and related risks were not considered as serious as they were, until Pakistan faced many distressing natural disasters after 1980's. In this respect, an event of earthquake in 2005 was proved to be a turning point for the government as they took some major steps for the preparation and mitigation of such disasters.

The main step was promulgation of National Disaster Ordinance in 2006 and, the NDMA[1] was formed. It is striking fact that NDMA could not show its efficiency during the terrible and devastating floods of 2010, the consequences of which are still being felt. Briefly, Pakistan's vulnerability to repetitive natural disasters warned the government about the hazard associated with climate change and natural disasters. In this regard, in 2005 the National environment and Climate Change Policy was formulated and the Planning Commission designed a special task team in 2008 to deal with various issues related to climate change in Pakistan, such as the rapid and irregular change in monsoon rains, the increased in dam's siltation, the melting of Himalaya glaciers, etc. (Hamid et al., 2011).

According to a report by CNN (Tim Hume, 2013), Pakistan is categorized in "extreme risk" zone of climate change and natural disasters. As per INFORM[2] (2015) risk index, Pakistan has the highest vulnerability towards natural disasters after Afghanistan as shown in the figure (1).

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[1] National Disaster Management Authority: Aim of NDMA is to deal with all disasters, natural or manmade, in multifarious manner ranging from preparation to rehabilitation and, to mobilize all organs of the state (national and provincial) at right time and place to mitigate the impact of disasters. Source: http://www.ndma.gov.pk/site/

[2] Index for risk management: It is a global, open-source risk assessment for humanitarian crises and disasters. It can support decisions about prevention, preparedness and response. Source: http://www.inform-index.org

Geographical position of Pakistan has made Pakistan a high risk disaster prone country. It has experienced massive losses due to floods, earthquakes, cyclones, land sliding and rise in temperature after 1980's and, these disasters caused the huge halts in the Pakistan's economy (see the Fig 2 and Fig 3).

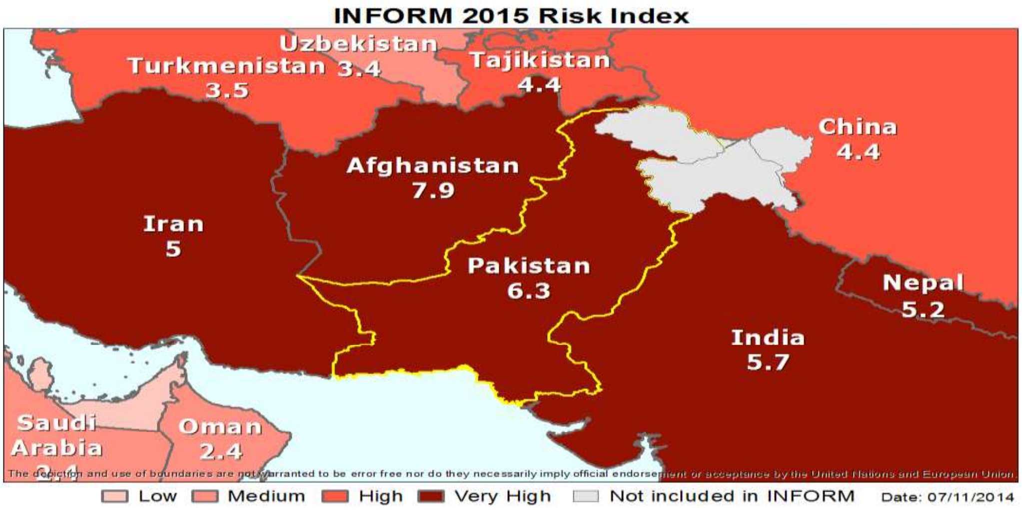

Fig 1: INFORM 2015 Risk Index

Source: http://www.preventionweb.net/countries/pak/data/

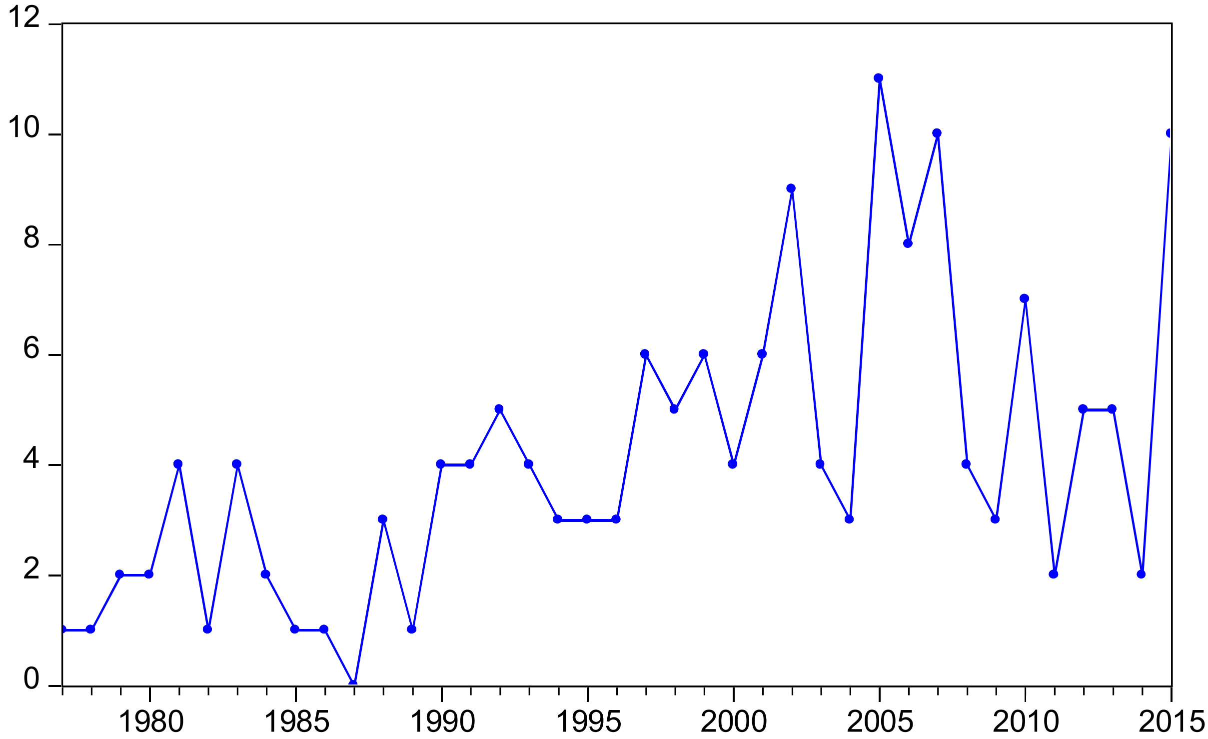

Fig.2.Trend in Number of Disasters During the Period 1977-2015.

Source: Author's own computation in Eviews-9 by using the data from EM-DAT

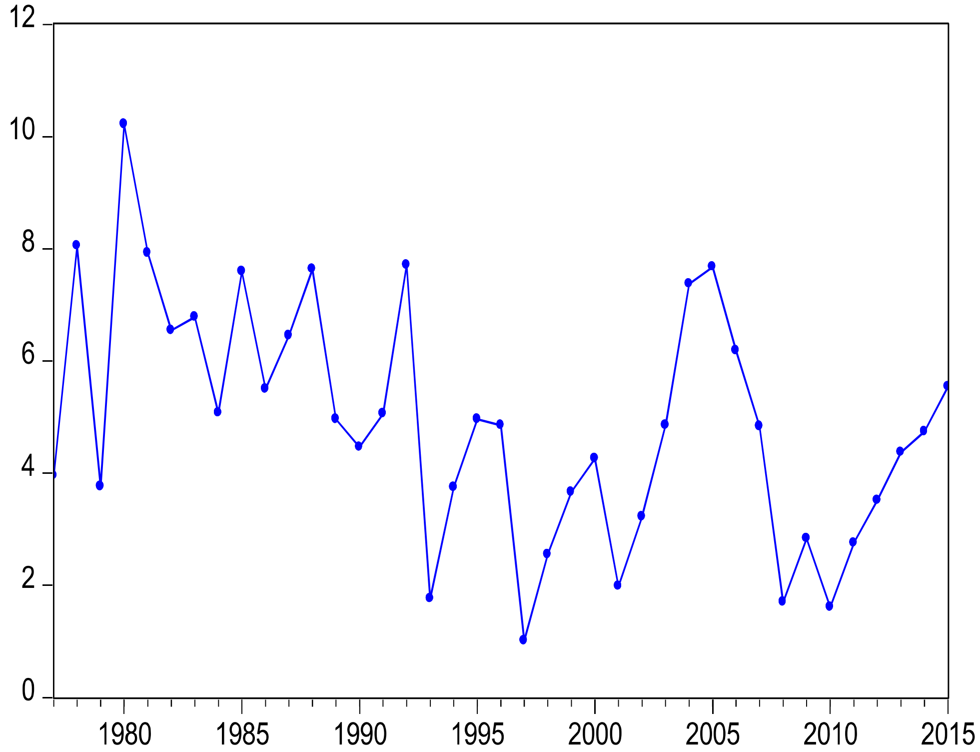

Fig.3. Trend in Real GDP Growth Rate(%age) During the Period 1977-2015.
Source: Author's own computation in Eviews-9 by using the data from World Development Indicators

3. Literature Review

From the empirical, theoretical and policy perspectives, the causal link among natural disasters and economic growth has significant suggestions. A unidirectional causality flow from natural disasters to economic growth points towards the dependency of economic growth on natural disasters, as an increase in natural disasters may spur or deteriorate economic growth. Unexpectedly scarce research has discussed the natural disasters-economic growth relationship (Shabnam, 2014). Having mix evidence in literature for economic growth-natural disasters nexus, still the results are inconclusive and vary from country to country (Fisker, 2012). Empirical studies show a positive association (Skidmore & Toya, 2002) as well as negative relationship (Raddataz, 2007, 2009; Noy, 2009) between natural disasters and economic growth.

Beginning from the eighteenth century, Mill (1848, p. 74–75) contributed a mutual relationship between disasters (Man–Made and Natural) and economic growth in his book principles of political economics. Mill (1848) described theoretically that no doubt disasters such as earthquakes, floods and wars made huge level destruction in the short–run but the disastrous effects used to recover in the long–run and things come on regular basis as it was before.

As per our information and knowledge, empirical work between economic growth and natural disasters nexus got its pace after 1970's. Out of which Long (1978) reported a negative impact of disasters in the third world countries. His study described that the developing Asian counties whose economies are highly dependent on agriculture adversely affected by the disasters which are increasing over the period of time.

The view of no causality between the natural disasters-economic growth relationships in long run was supported by the study of Albala-Bertrand (1993). Albala-Bertrand (1993) tested the empirical relationship by regression analysis between large natural disasters and economic growth of 28 low or middle income nations during the span 1960-1979. His study documented a slightly positive significant effect of natural disasters on economic growth in the short but no significant relationship observed in the long run. Albala-Bertrand (1993) used a small sample size so may not provide very robust results. He took only twenty eight individual disasters which all occurred in different countries at different times, so this study considered too small to deliberate generalization or deductions of effects of natural disasters. Albeala-Bertrand (1993) used simple regression analysis to show the overall effect of natural disaster but different analysis could give more vision about effects of natural disasters. Freeman (2000) exhibited the relationship of natural disasters to poverty and infrastructure. The infrastructure can be considered as a significant factor of economic growth as World Bank already has found that investments in infrastructure programs of agriculture lessen the poverty from rural areas and increase gross domestic product (Freeman 2000). The destruction of infrastructure due to natural disasters has put negative impacts on poor's economic condition. Therefore, right to use of infrastructure can be observed as a measure of poverty. This clear relationship between infrastructure and poverty, helped to measure the effects of natural disasters on low income sector.

Skidmore and Toya 2002 did a cross country empirical study by taking a sample of 89 countries to measure the long run relationship between natural disasters and economic growth for the period 1960-1990. The results of his study demonstrated a positive relationship between climatic disasters and economic growth in the long-run. He documented that positive relationship is due to progress in technology and human capital investment.

Kahn (2005) took the data about natural disasters from 73 counties across the world from 1980 to 2002. He observed the influence of climatic disasters on different segments of economy. His study acknowledged an important fact that all nations whether poor or rich face same quality and amount of tremors but the high GDP per capita in rich countries is a reason of bearing less loss in terms of human capital during these shocks.

Loayza et al. (2009) conducted a cross country study of 94 countries during the period 1961-2005 and, saw some mixed results. They observed that results vary from type to type of natural disaster and sector to sector of the economy. Their study found that droughts likely to decrease economic growth while floods put a positive influence on economic growth. Further, they observed that droughts negatively affect agriculture growth while floods expected to increase agriculture growth. Their study may motivate the researchers to further test the empirical nexus between natural disasters and economic growth at individual country level to provide additional insights.

Some authors also tried to predict the effect of natural disasters on microeconomic and financial indicators. For example, Gourio (2008) tried to provide evidence among natural disasters and capital stock prices. He found an uneven type of relationship between them. In another study Nakamura et al. (2010) reported the relationship between consumption growth rate and natural disasters. He found that natural disasters cause an increase in the uncertainty of consumption growth rate.

The literature on linkage of growth models to natural disasters is still limited and growing. The aforementioned discussion and results may be a little bit surprising and confuse us to make a logical conclusion. The estimation from growth theory of natural disaster effects on GDP is also diverging. For instance, there is prediction by standard neoclassical growth theories that after disaster, destruction in capital stock per worker increase the growth temporarily by accelerating the marginal return; however it would slow down with the reduction in effective workers (Okuyama, 2003). As per certain endogenous growth models, from the preceding growth course, the damage in human or physical capital can leave negative deviation permanently if positive spillovers from the present human and physical capital stock are adequately strong (Romer, 1990).

4. Valuation tools and empirical investigation

4.1. Cointegration—ARDL bounds testing procedure

We use a recent technique i.e. autoregressive distributive lag model (hereinafter referred to as ARDL) bounds testing approach in order to estimate the natural disasters-economic growth long run relationship. We follow the ARDL bound testing technique as developed by Pesaran et al.(2001) which unlike other traditional co integration techniques is very effective even for different levels of integration and small sample sizes having 30 to 80 observations. On the other hand, the traditional cointegration approaches are sensitive to the small sample sizes. The ARDL bound testing technique even takes into the account the endogenous regressors and mostly delivers un-biased estimates in the long-run and valid t-statistics value (Harris et al., 2003).

Moreover, some researchers claimed that differencing the variables to make them stationary may damage an important part of data info associated with the co-movements (Gune 2007). So, ARDL bound testing approach is a better analysis technique and provides improved and unbiased results (Haug 2002; Alimi, 2014).

The auto regressive distributive lag model equation of relationship between natural disasters and economic growth equation can be formulated as:

$$\Delta GDP_t = \alpha_0 + \alpha_1 GDP_{t-1} + \alpha_2 DIS_{t-1} + \sum_{i=1}^{n} \alpha_3 \Delta GDP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta DIS_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta DIS_t = \beta_0 + \beta_1 DIS_{t-1} + \beta_2 GDP_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta DIS_{t-i} + \sum_{i=0}^{n} \beta_4 \Delta GDP_{t-i} + \varepsilon_t \quad (2)$$

Where, GDP_t is the annual real GDP growth rate, DIS_t is the loss of natural disasters (Measured from No. of Deaths, No. of affected people, frequency of disasters). ε_t is a white noise error term, having zero mean and constant variance. . We use world development indicators (WDI) to collect data for real GDP growth rate of Pakistan. We collect data for frequency of disasters, number of deaths and total number of people affected due to each disaster from the networks EM-DAT (CRED 2010). Due to the non-availability of data before 1977 for consecutive years, the study is limited over the period 1977-2015.

Skidmore et al. (2002), Okuyama (2003), Noy (2009), Bergholt et al. (2012), Guo et al. (2015), suggested that the rate of occurrence of disasters and level of damages are the most valuable while choosing the measurement proxy of natural disasters. The rate of occurrence of natural disasters can be referred as the frequency or number of disasters. The level or magnitude of damages consists of three main facets i.e. number of deaths, number of people affected and loss in economic form. In fact, EM-DAT includes the data on frequency of disasters, number of deaths and number of people affected during each disaster. Therefore, proxy calculated for natural disasters include the data for all the above mentioned main aspects.

We normalize all natural disasters in an identical way as Noy (2009) and Bergholt & Lujala (2012) did. To calculate the amount of a disaster, we divide the total affected population by total population of the last year. The lag figure of population is used in order to make sure that the catastrophic event effect does not enter into the denominator.

Also, we have to rectify the time of event, as an event occurred in January may create a greater impact on the growth of current year than an event occurred in December that is probably to influence the next year's income. To meet this issue, we weight the time elapsed since an event occurred using the reduction rate (12–event month) /12, e.g. if the event months is one (January), we multiply the normalized figure of the population by one. Similarly, if an event occurred in the month of June (Event Month 6), we multiply the normalized population by 6 and so on. In case, if several events took place in a particular year then an aggregate figure is calculated from all the individual values. In this way, we can calculate the annual, normalized and time adjusted size of the population in the following steps:

$$\text{Annual, Normalized Size of the Population} = \sum_{i=1}^{n} \frac{\text{Total Affected Population during a year}}{\text{Total Population in the last year}}$$

$$\text{Time Adjusted Weighted Size} = \frac{12 - \text{Event Month}}{12}$$

Hence, Annual, normalized and time adjusted Size of population is

$$\sum_{i=1}^{n} \frac{\text{Total Affected Population during a year}}{\text{Total Population in the last year}} \times \frac{12 - \text{Event Month}}{12} \quad (3)$$

We use the numerical value obtained from equ.(3) as a proxy for the loss of natural disasters.

As mentioned earlier, we use the ARDL bounds testing technique to find out the cointegration vector. ARDL bound testing procedure is based on the Wald test statistic. In equation (1), the level relationship can be described as follows:

Null hypothesis Ho: $\alpha_2 = \alpha_3 = 0$ (No cointegration)
Alternative hypothesis H1: $\alpha_2 \neq \alpha_3 \neq 0$ (There is level relationship)
In equation (2), the level relationship can be described as follows:

Null hypothesis Ho: $\beta_2 = \beta_3 = 0$ (No cointegration)

Alternative hypothesis H1: $\beta_2 \neq \beta_3 \neq 0$ (There is level relationship)

ARDL bound test is interpreted by two types of bounds known as upper critical bound value I(1) and lower critical bound value I(0) (Pesaran and Pesaran ,1997; Pesaran et al. ,2001). If the estimated value of F-statistic surpass the I(1) value then we reject H_0, it implies that there exists a co-integration vector and therefore, a long-run relationship among the variables of study. However, if the F-statistic value falls in between the upper and lower critical bounds then we say that analysis is inconclusive. Conversely, if we found F-statistic value lies under the lower critical bound then we take it as an existence of no co-integration vector and hence, no long-run relationship exists among the variables.

4.2. Granger non-causality test

According to the Granger (1988) causal relationship can be tested within the framework of Error Correction Model (Hereinafter referred to as ECM). ECM is related with the multiple time series models usually applied for the data when the primary variables have long run stochastic trend that is also called as cointegration. Basically, the ECM are based on theoretical framework and used to predict the short-term and long-term influence of one time series over another. ECMs calculate the rate at which the variable of interest moves back towards the equilibrium after a variation in other variables and hence, represent the short-run dynamics.

The traditional explanation of Granger's test is based on the idea that future event cannot be reason for the event occurred in past, but past event can be the reason for future event (Takaendesa & Odhiambo, 2007). The basic definition of Granger causality test states that "a time series dataset of one variable say H_t, causes another time series data set say I_t, if better forecasting of I_t occurred by implying values from previous period of H_t and, if those values from the past can improve significantly the forecasting of I_t, then we can say H_t granger causes I_t. We may also check the reverse causality from series I to series H in the similar fashion. Granger Causality test approach test the following null hypothesis: H_t does not cause I_t and, I_t does not cause H_t is being tested. The above mentioned null hypothesis is tested by the following two regression equations:

$$I_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} I_{t-i} + \sum_{i=1}^{n} \beta_{1i} H_{t-i} + \mu_t \tag{4}$$

$$H_t = \beta_0 + \sum_{i=1}^{n} \alpha_{2i} H_{t-i} + \sum_{i=1}^{n} \beta_{2i} I_{t-i} + \varepsilon_t \tag{5}$$

Where μ_t, ε_t are white noise error terms and i is the number of lag terms varies from 1 to n for a particular variable. The Null hypothesis (H_t does not Granger cause I_t) will not be accepted if β_{1i} are jointly significant (Granger, 1969).

We adopt the granger causality ECM test approach in this study because it can deal with both large and small sample sizes and thus having a comparative advantage over the other traditional tools (Gulikey and Salemi 1982; Gewekeetal 1983). Some other authors also suggested some other alternative techniques to check the causality (See Studies by Sims, 1972; Pierce & Haugh, 1977; Geweke, 1982). But, conventional view of causality test undergoes from two procedural flaws (Odhiambo, 2004). Firstly, these typical tests do not analyze the essential characteristics of time series data. If the variables are co-integrated, afterward these approaches inferring various variables will be misleading until the lagged error-correction term is introduced (Granger, 1988). Secondly, the traditional techniques difference the variables unconsciously and make the time series stationary make the time series stationary, as a result, exclude the long run evidence represented in the raw form of the variables. So, error-correction based causality is a better technique to apply as it includes the lag terms which overcomes the aforementioned weakness of the other alternative Granger Causality techniques.

The causality test is thus determined by the following ARDL models:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta DIS_{t-i} + ECM_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta DIS_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta DIS_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta GDP_{t-i} + ECM_{t-1} + \varepsilon_t \quad (7)$$

Where ECM_{t-1} represents lagged error- correction model term being derived from cointegration equation of ARDL bound test.

The ARDL bound testing approach suggests that along with a long run relationship between the natural disasters and economic growth, there must be at least uni-directional Granger causality between them. Unfortunately, the direction of causality between the variables cannot be determined without estimating the F-statistic and the lagged error-correction term. If we interpret the Granger Causality test, the F-statistic value on the explanatory variable determine the short-run causal effects and, long-run causal effects can be estimated by the coefficient of the lagged ECT. Although we have included ECTs in both the equation (6) and (7), but a noteworthy thing is that, only the equation having rejected null hypothesis i.e. existence of a cointegration vector would be allowed to estimate with an ECT (See Studies by Narayan and Smyth, 2006; Morley, 2006).

4.3. Empirical Analysis

4.3.1. Unit Root Test

Pesaran et al.(2001) and Narayan (2005) calculate the upper bound and lower bound F-statistic values of ARDL bound approach by assuming that none of the series should be integrated of order 2 or I(2). So, it is mandatory to check the stationarity of variables and ensure that all the series are either integrated at level (I (0)) or order 1(I (1)) and none of the series is stationary at 2nd difference. And if it happens then F-Test is going to be spurious.

It is noticed that a non-stationary time series data contains diverse means at different points in time, and variance of non-stationary time series tends to increase with the size of sample (Harris et al., 2003). Non-stationary time series contains a very critical characteristic in the manner that any linear combinations of such time series data make spurious regression (Granger et al. 1974). And, whenever a researcher come across spurious regression, t-values of his research may be highly significant, coefficient of determination (R^2) is nearly approaching to one and Durbin Watson (DW) statistic value is very low. Such type of analysis may misguide researchers and lead them towards Type 1 errors (Granger et al. 1974), which follows the results and analysis to be biased. Therefore, it is required to identify the stationarity or non-stationarity of time series data to get your research protected from spurious regression problem.

We apply the Augmented Dicky- Fuller (hereinafter referred to as ADF) unit root test to check the stationarity of variables. The results of ADF test indicate that economic growth is stationery at level and natural disasters is found to be stationary at 1st difference. Table 1 reports the results of ADF test which justify the assumption for any time series not to be integrated of order 2 or I(2) and allow us to apply ARDL bound test.

Table 1

ADF Unit Root Test Results

Variable	Trend	No Trend	Stationary Status	Order of Integration
GDP	-4.9114***	-3.9168***	Stationery	I(0)
DIS	-9.2742***	-9.2551***	Stationery	I(1)

Note: *** indicate Mckinnon (1996) critical values at 1% level

4.3.2. ARDL Bound Test

We investigate the long-run relationship between [GDP, DIS] and [DIS, GDP] in this section. Where GDP is economic growth (measured from real GDP growth rate) and DIS is the estimated loss of natural disasters (a figure calculated from equ.1) .Before ARDL bound test we need to select lag length for our eqs. (1) and (2). We use four different criterion i.e. FPE (Final Prediction Error), AIC (Akaike Information criterian), SBC (Schwarz Bayesian Information Criterion) and HQ (Hannan-Quinn Information Criterian) to determine the lag length. The results of different lag length criterion (Results are not reported here) show that one (1) is the optimal lag length. After having the optimal lag length, we further perform the ARDL bound test to examine the long-run relationship between [GDP, DIS] and [DIS, GDP] (see results of table 2).

Table 2

Bounds F-test for cointegration

Dependent Variable		Function		F-Test Statistics	
GDP		GDP(DIS)		5.6192**	
DIS		DIS(GDP)		2.560	
Asymptotic Critical Values					
1%		5%		10%	
I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
5.73	6.480	3.957	4.530	3.223	3.757

Note: ** denote statistical significance at the 5% level. Asymptotic critical value

In the first case, we keep GDP as dependent variable and noticed that F-statistic value exceeds the upper-bound critical value at 5% significance level. So, we infer that there exists a cointegration vector between [GDP, DIS] and hence a long-run relationship. In the latter case, we keep DIS as dependent variable and found that F-statistic value falls under the lower critical bound at 10% significance level. Hence, we could not find long-run relationship between [DIS, GDP].

4.3.3. The dynamic of causality based on error-correction model

The presence of a long-run relationship from DIS towards GDP in Table 2 allows us to test for the causality into equation (5) only by including the lagged ECT. We examine the causality by the coefficient of the lagged ECT which should be negative and statistically significant. Further, joint significance is examined through Wald test. We report these results in table 3 and table 4.

The empirical results described in Tables 3 & 4 indicate that there exists a unidirectional causality flow from DIS towards GDP both in the short-run and in the long-run (See Summary in Table 4). The coefficient of lagged ECT is negative and statistically significant as reported in Table 3 hence, there exists a long-run causality from natural disasters to economic growth. We can also notice a short-run causal link from natural disasters to economic growth as the F-statistics value is statistically significant at 1% significance level (See Table 3).

Table 3

Granger non causality tests

Dependent Variable	Casual flow	F-Statistics	t-test on ECM	R^2
Economic Growth	Natural Disasters–economic growth	6.3204(0.0047) ***	-1.8989**	0.33
Natural Disasters	Economic growth–Natural Disasters	2.3736(0.1089)	-	0.54

** and *** are statistical significances at 5% and 1% Levels, respectively

The reverse causality as expected from economic growth to natural disasters, though, is rejected (See Table 3 for Coefficient of lagged ECT and F-Statistics Values).

Table 4

Summary of ARDL Bound and Causality Tests

Variables	Causal Link	Conclusion
Economic Growth(ΔGDP) and Natural Disasters (ΔDIS)	Discrete Unidirectional Causality from Natural Disasters to Economic Growth	Natural Disasters Cause Economic Growth

A summary in table 4 show that there exists discrete uni-directional causality from natural disasters to economic growth.

5. Conclusion

The current study is meant to provide further empirical evidence on the natural disasters-economic growth relationship in Pakistan by using the ARDL-bound test. The empirical results of this study illustrate that there is a distinct unidirectional causal flow from natural disasters to economic growth, both in the short run and in the long run. The results also show that there is a prima facie causal flow from natural disasters to economic growth. Overall, the study finds that natural disasters deteriorate economic growth in Pakistan.

Here, a point to be keep in mind that GDP, though usually used to quantify the level of development, can not a measure of wealth or well-being. Therefore, it is not the end objective to observe the development. These results of the current study may lead to observe which nations and class of people are adversely affected by natural disasters and which are gaining from economic incentives in term of aid dollars. The findings may also lead towards a deep thinking in order to re-examine the financial assistance projects so that the financial assistance might be improved, regulated and accountable to mitigate and balance not only the country's economy but also the routine life and welfare of people.

Last but not the least, having scant investigation and mix evidence, this area of research requires further literature especially at individual country level in order to provide some conclusive and convincing findings. With the passage of time, summing up the results at individual country level may suggest some proactive measures and prepare each individual nation to combat efficiently.

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