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Impact of Disaster Related Mortality on Gross Domestic Product: A Case Study of Pakistan

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ABSTRACT

Disaster related mortality is a growing economic concern in the Asian countries. These deaths are hypothesized to have a significant impact on per capita gross domestic Product (GDP) of the countries. The objective of the study is to empirically examine the impact of disaster related deaths on economic growth of Pakistan, by using ordinary least square method (OLS) during 1975 to 2009. The results reveal that there is a significant and positive impact of disaster related mortalities, human capital, gross investment and life expectancy on economic growth of Pakistan, while there is a negative impact of arable land, net exports and labor force on GDP per capita. The results imply that disaster significantly increase foreign aid which ultimately increases economic growth of Pakistan.

Keywords: Disaster, Mortality, Gross domestic product, Ordinary least square regression, Pakistan.

Jel classification code: H84, Q54, O4

INTRODUCTION

Disasters are as old as the history of man but the dramatic increase in their number of occurring and loose both in terms of property and human lives caused by them in the recent time have become a cause of national and international attention. There are several reasons of increase in happening of natural disasters. Human activities that adversely affect the environment play an important role in the severity and frequency of disasters. Disruption caused by man in the balance of environment results in natural disasters. The human factor raises the cost; in both loss of life and property

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damage. Prevention of natural disasters is possible at some extent by understanding their real causes. Not only the global warming but different environmental changes results in sudden disasters which occurred around the world. The effects of these events may be immediate and sustained time. According to the Center of research on the Epidemiology of disasters (CRED, 2011), natural disasters are occurring with greater frequency and ferocity. The number of natural disasters has more than doubled since the years 1980-89 and its economic cost also increased. Direct economic losses from natural disasters multiplied five times in 1985-2005 it was $ 629 billion in 1999-and 2008 it was increased to 108 billion dollars.

Large sudden natural disasters such as Floods, tsunamis, earthquakes and hurricanes generate destructive impacts both to people by deaths, injuries and rendering homeless and to physical capital by destroying infrastructure and property. Extensive research in both physical and social sciences has been concentrated to increasing ability to predict natural disasters and prepare for them before occurring, to decrease its direct cost. However research in economics on the impact of natural disasters is fairly limited (Cavallo *et al* 2011). Deaths occurred due to natural disasters affect the GDP in several ways, for example they reduce the number of labor force involved in production process. Deaths of earning hands of the family reduce the consumption level, government tax revenue, private savings and investments. Government, non government organizations and household forced to divert their resources from productive sectors to the reconstruction and rehabilitation programs. Due to the high level of poverty, after disaster many children are forced to drop out the school in order to compensate for the income reduction by their participation in labor market. This phenomenon adversely affects the human capital creation for future and then GDP of the country. Table 1 shows classification of natural disasters for ready reference.

Natural disasters are considered as a great shock to an economy. The impact of natural disaster varies with the scale of economy and their ability of reconstruction and rehabilitation after the disasters. Natural disasters tend to deteriorate or destroy physical and social infrastructure, change the environment, and cause economic stress. To the population, they cause loss of property and impacts on livelihoods,

Table 1 Classification of natural disasters

Disaster	Sub Categories
Geophysical	Earthquake, Volcano , Tsunamis, Volcanic eruptions
Meteorological	Hurricanes, hailstorms, tornadoes, typhoons, snowstorms, cold pells, and heat waves.
Hydrological	Hailstorms and snowstorms Sea surges, Floods and Droughts
Climatologic	Extreme temperature, Drought, Wildfire
Biological	Epidemic ,Insect infestation

Source: (CRED 2011)

and disruption to family and social relationships. Moreover, natural disasters affect the performance of the economy by changing the level and structure of public expenditure, usually hurting the current level of public services and future public investment, and reducing transfers, particularly to the disenfranchised and poor. Sometimes this sets back long-term development projects that ultimately affect those with lower income levels (Ibarraran *et al* 2009).

The growth rate of GDP falls because there is usually a significant fall in production, particularly in the case of hurricanes, floods, or droughts. These events are typically perceived to primarily affect the agricultural sector, in addition to other primary activities such as forestry and fisheries. However, hurricanes and floods may have effects on other sectors such as tourism that rely heavily on the existence of natural capital. The manufacturing Sector may be affected as well, in part because of a decrease in activity due to the disruption of transportation and a reduction in production capacities. Transportation is commonly affected because natural disasters tend to hurt roads and bridges. Production capacity falls because of a delay in inputs such as water, energy, and materials, and because of direct effects on workers and their productivity (Albala-Bertrand, 1993).

Disaster-related deaths are a growing economic concern for Pakistan economy. These deaths are hypothesized to have a significantly negative impact on per capita gross domestic Product (GDP) of the country. The objective of the study is following i.e.,

1. To test the hypothesis that disaster related mortalities have negative impact on the per capita GDP of Pakistan.
2. To find out the annual loss to the per capita GDP attributed to per disaster related death.

To the best of our knowledge, no study has attempted to estimate the effects of disasters related mortalities on the per capita GDP of Pakistan. The main objective of this study is to bridge this gap of knowledge and fill this empty field of research in Pakistan.

The remaining portion of the study is organized as follows. Section 2 explains the historical perspective of natural disaster in Pakistan. Section 3 reviews existing literature on disaster related mortalities. Section 4 present data sources and estimation techniques. Section 5 contains the results of double log model and their discussion. Final section concludes the study.

HISTORICAL PERSPECTIVE OF NATURAL DISASTERS IN PAKISTAN

Pakistan continues to suffer from natural disasters and they affect its citizen's lives and livelihood like the other south Asian countries. The human impact of

these disasters can be analyzed by the fact that in period 1993 to 2003 about 6,037 people were died and 8.9 million were affected by different natural disasters in Pakistan (World Disasters Report, 2003). Due to the high unpredictability and lack of proper institutions for handling the sudden situations, thousands of lives are lost in Pakistan in different natural disasters. Pakistan is an agriculture based economy and it accounts for one forth of our GDP. We mostly rely on water resources for irrigation purposes which depend on monsoon rainfall. If it is less than required rate then we suffer from drought situation and on the other hand when it is more than need it results in flood. Extreme weather events destroy the crops and adversely affect the soil of the arable land. It may result in destruction of infrastructure, energy insecurity, deterioration of natural ecosystems and political and economic instability in the country. To face this situation sustainable development is the only way forward. In terms of frequency and potential impact upon large numbers of people/livelihoods, the most devastating hazards in Pakistan are floods, droughts, cyclones and earthquake. All the disasters had a significant negative impact on human life, property, Infrastructure, service delivery and economic activity (UNDP, 2008). Table 2 shows the eight apex natural disasters in Pakistan.

Table 2 Top Eight Natural Disasters in Pakistan

Year	Disasters	Died	Affected	Damages (In US dollars)
2010	Flood	1542	11,581,875	-
2005	Earth quake	74,000	2,869, 142	5,000,00
2005	Flood	-	7,000,450	-
2003	Flood	-	1,266,223	-
1998	Flood	1,000	-	-
1996	Flood	-	1,300,000	-
1992	Flood	1334	12,324,024	1,000,000
2000-02	Drought		2,200,000	247,000

Source: CRED (2011).

Although prevention from the natural disasters is not possible for the man but better preparedness for such situation and after occurrence of them, effective response can reduce the loss of human lives and destruction of capital.

LITERATURE REVIEW

Natural disasters are usually discussed in terms of relative destructiveness and are compared in terms of human fatalities, injuries and displacement, direct economic losses, and indirect costs from infrastructure loss and capital needed to replace it. These latter costs refer to the foregone production derived as a result of disasters. Secondary costs, namely the macroeconomic implications of such disasters, are

rarely calculated, and non-monetary costs-beyond loss of life or health are hardly ever assessed. Non-monetary costs include stress to individuals and communities, deterioration of family relationships, and damage to the social fabric (Ibarrara *et al* 2009).

By analyzing the 28 cases of large natural disasters over the 20 years from 1970-1990 in United Kingdom, Albala-bertrand (1993) presented the macroeconomic model for the sudden disasters impact on economic growth. Findings of the study reveal that level of GDP does not fall in disasters situation nor the growth rate is affected. It does not stimulate the inflation rate but increase the gross fixed capital formation as a result of construction activities. Agriculture sector remain unaffected and public deficit and trade deficit increase sharply. Macroeconomic studies have found that natural disasters may lead to an immediate contraction in economic output, a worsening of a country's balance of trade, a deterioration of the fiscal balances, and an increase in poverty, usually accompanied by an increase in income disparities. Each of these macroeconomic impacts is closely related to each other.

To find out the impact of natural disasters on Fiji economy, Narayan (2003) by employing the computable general equilibrium model examines macroeconomic effects of disaster in the short run. Study reveals that both imports and exports fall after the cyclones and results in negative balance of payment. He said that fall in income, consumption, savings and investments as a result of natural disaster, negatively affect the real GDP of the country. Skidmore & Toya (2006) examine the degree to which the human and capital losses from natural disasters are reduced as countries develop by using annual data of 151 countries over the time period of 1960-2003. They conclude that not only the income level of the country is important measure of development in reducing disasters related mortalities and capital losses but openness of the economy and higher education level of the country is also important. As countries develop they allocate greater resources to safety including precautionary measures for reducing the impact of natural disasters.

According to Popp (2006) the key macro economic variables which are affected by the natural disasters in long run are: physical and human capital accumulation, natural resources and technology. A positive or negative effect of natural disasters depends on the recovery progress after the disasters and on the nature of the disasters. Geological disasters have negative impact on output while climatic disasters can have positive relation with output in long run. Response of the countries and institutional set is very much important in the case of natural disasters. Masozera *et al* (2007) find out the elements of vulnerability to natural disasters in the context of Hurricane Katrina. They analyze that whether the impact of Hurricane Katrina on the neighbors of the New Orleans is different on the basis of pre existing social, physical and economic vulnerabilities. Results of the study show that Hurricane Katrina caused severe flood damages in the neighbors of the New Orleans regardless of elevation and income level. However particular classes

respond differently on the basis of pre existing social and economic differences. These differences play important role in response of the people and their ability to cope with the disaster. The special issues in Ecological economics of coastal disasters are introduced by Farley & Costanza (2007). According to them if we measure in terms of human capital lost, physical infrastructure, capital destroyed, ecological damages, coastal disasters are increasing both in magnitude and frequency. The Indian Ocean tsunami and Hurricane Katrina were the worst disasters for human well being. The main emphasis of economics should be to improve the well being of the people and introduce the system by which people can invest and protect all type of capital. All the available resources should be allocated efficiently and with equity for the sustainable economic development and well being of the people.

Comparison of different countries regarding the effects of natural disasters is difficult because there difference in location, income level, population and number and intensity of disasters from which they suffer. Monetary damages are mostly higher for larger and industrialized countries because of the accumulated value of their monetary assets at risk. To examine the positive economic consequences of natural disasters through the replacement of capital or productivity effect, Dumas & Hallegatte (2008) concluded that disasters can influence the production level but not the growth rate. Depending on the reconstruction and rehabilitation ability, disasters impacts can be increase and decrease the impact of disasters but never lead to a positive event. The effect of natural disasters on selected components of GDP ultimately traces back to a fall in GDP per capita and to lower real income levels. When income levels fall, there is an increase in poverty since people have fewer resources available to fulfill their needs. If the relative income level of different groups is affected, income disparity swells. Usually when income level drops, it is also redistributed and disparity increases, because more resources flow toward the rich (the capital assets they hold are now scarcer and the value of these assets is increased) and less to the poor. Thus, natural disasters tend to increase poverty and worsen income disparity.

By employing the regression analysis, Noy (2008) examine the macro economic consequences of natural disasters. He used the data of 109 countries for the time period of 1970-2003 and find out that there is no correlation between the GDP growth rate and number of the people affected in natural disasters. However capital loose and property damage is negative determinant of the economic growth. Small economies face larger output decline then the bigger economies or developed nations. Counties with higher per capita income, higher literacy rate, and greater openness of trade are better able to absorb the negative shocks to the economy. Countries having more foreign reserves and high level of domestic credit have less adverse impact on the domestic production. Heger *et al* (2008) analyzes the economic impact of natural disasters as a case study of Caribbean. By following the simple OLS estimation technique for the time period 1970-2006, his study covers the 16 Caribbean states. Results show that Disasters lead to destruction of

the productive economy and decrease the growth, worsening the fiscal balances and external balances in long run. In order to investigate the impact of natural disasters on economic growth, Loayzar *et al* (2009) used cross country panel data of 94 countries including both, developing and developed countries. By employing the Generalized Method of Moments on cross country panel data from 1961-2005, they draw three important conclusions. Natural disasters do not always affect the economy negatively and their impact varies across disasters and sector of the economy. Secondly moderate natural disasters can have positive impact on the some sectors but severe disasters never impact the economy positively. Third, growth rate of the developing countries are more sensitive to the natural disasters then the developed one. To find out the relationship between the risk of natural disasters and investment in education sector, Cuaresma (2009) used the data of average secondary school enrolment for 170 countries covering the time period from 1980-2000, against different measures of natural disasters risk. After employing the Bayesian model averaging techniques, empirical findings indicate that there is negative partial correlation between geological natural disasters risk and secondary school enrolment in long run. In short run natural disasters cause instability and increase output volatility but in few years' economic impact of natural disasters vanish. The long run effects arose the countries do not depend on human capital accumulation and income level of the respective country, so effects are homogenous. There is no role of political regime in the effect of natural disasters risk on human capital accumulation.

By using a panel autoregressive Distributed lags (PARDL) model, Raddatz (2009) estimate the macroeconomic cost of natural disasters for developing countries. He estimated the output impact of natural disasters for the time period 1975-2006.Estimation of panel ARDL and panel VAR models show that climatic disasters reduce the per capita GDP by 0.6 percent. Natural disasters occurred in the last decade result in important macroeconomic cost in which droughts have largest average impact, one percent of per capita GDP. Countries having low income respond the climatic disasters more strongly because of higher response to the droughts. Small countries are more vulnerable to windstorm then other countries but show same response to other type of natural disasters. Findings exhibit no relationship between the output impact of any natural disasters and external debt of the country. Study indicates that foreign aid flows have done little to attenuate the output results of climatic disasters.

Impacts of natural disasters and political risk on the international trade are analyzed by Oh & Reuveny (2009). They employed ordinary least square for estimation and their sample includes 116 countries from 1985 to 2003.Their results show that increase in incidence of disasters and political risk either in importer or exporter country, negatively affect the bilateral trade. The countries whose have less political risk and comparatively safe, see smaller decline in their trade flow after facing the natural disasters. Their findings suggest that the marginal effect of

political risk becomes more negative as the number of natural disasters increase. As a result of climatic changes in the world, if climatic disasters increase then growth of the economic globalization may decline over the time, other things remaining constant.

To find out the relationship between economic impact of natural disaster and economic condition, Padli *et al* (2009) employ regression analysis for three sets of cross-sectional data of the time period 1985, 1995, and 2005 covering 73 countries. Study concludes that there is strong relationship between the income of the country and impacts of natural disasters. Wealthy nations are better prepared for the disasters situation and have less negative effects on the economy after its occurrence. The strength of the event, the vulnerability of the people and their economic activity, and their ability to cope with the disaster determine the severity of the disaster's effect. Hence, one may find moderate natural events that map into severe natural disasters due to the vulnerability of a particular population, as well as severe natural events that result in moderate natural disasters due to preparedness of people and institutions.

By using the dataset of 202 countries (Cavallo *et al* 2009) find out the long and short term effects of natural disasters. Findings of the study suggest that larger natural disasters negatively affect the per capita GDP both in long run and short run but small disasters have no output affect. To investigated the effects of natural disasters on long term economic growth (Kim 2010) use the data set of 88 countries concludes positive and statistically significant relationship between the growth rate and number of natural disasters. He also concluded that there is no significant relationship between the investment to GDP ratio and any kind of disaster. To analyze the macro economic impacts of disasters in Vietnam, Noy & Vu (2010) use the provisional data for primary and secondary industries and employ the Blundell-bond general method of moments. Results shows that in terms of human capital disasters negatively impact the growth but in terms of capital destruction they are appear to boost the economy in Short period of time. Impact of disasters on different region is significantly different because their access to the reconstruction funds both by government and private sector are different. Richer and less remote areas show comparatively more development after the disasters.

By analyzing the dataset of 196 countries (Cavallo *et al.* 2011) suggested that only extremely large disasters have negative impact on output both in short and long run. Income distribution plays a role in determining the death toll from natural disasters. Controlling for differences in GDP, countries with a higher Gini coefficient experience a higher death toll from natural disasters. Thus, improving income distribution is crucial because a more equitable income distribution is usually associated with a better distribution of coping abilities. Population density and land extension also dictate deaths from natural disasters. Japan would experience a much higher death toll than less densely-populated countries. Table 3 reports the

selected recent studies and their results of empirical relationship between disaster related mortalities and economic growth.

Table 3 Summery of literature review

Year	Author	Key Findings
1993	Albala-bertrand	• Disasters neither fall level of GDP nor the growth rate. • It does not stimulate the inflation rate. • Disasters increase the gross fixed capital formation as a result of construction activities.
2003	Narayan	• Fall in income, consumption, savings and investments negatively affect the real GDP of the country.
2006	Skidmore & Toya	• Not only the income level of the country is important in reducing disasters related mortalities but capital losses openness of the economy and higher education level of the country is also important.
2006	Popp	• Geological disasters are negatively correlates with output while climatic disasters can have positive relation in long run.
2007	Masozera	• Hurricane Katrina caused severe flood damages in the neighbors of the New Orleans regardless of elevation and income level.
2007	Farley & Costanza	• The main emphasis of economics should be to improve the well being of the people and introduce the system by which people can invest and protect all type of capital losses due to disaster.
2008	Dumas & Hallegatte	• Disasters can influence the production level but not the growth rate. • Disasters impact can be increase or decrease but never lead to a positive event.
2008	Noy	• There is no correlation between the GDP growth rate and number of the people affected in natural disasters. However capital loss and property damage is negative determinant of the economic growth.
2008	Habibullah & Padli	• Larger land area and education attainment reduce fatalities as a result of disasters • Larger population increase deaths payment.

Table 3 (*Con't*)

2008	Heger *et al*	• Natural disasters do not always affect the economy negatively and their impact varies across disasters and sector of the economy. • Moderate natural disasters can have positive impact on the some sectors but severe disasters never impact the economy positively. • Growth rate of the developing countries are more sensitive to the natural disasters then the developed one.
2009	Cuaresma	• There is negative partial correlation between geological natural disasters risk and secondary school enrolment in long run. • In short run natural disasters cause instability and increase output volatility.
2009	Raddatz	• There is no relationship between the output impact of any natural disasters and external debt of the country. • Foreign aid flows have done little to ease the output results of climatic disasters.
2009	Oh & Reuveny	• Disasters and political risk negatively affect the bilateral trade.
2009	Padli *et al*	• There is strong relationship between the income of the country and impacts of natural disasters. Wealthy nations are better prepared for the disasters situation and have less negative effects on the economy after its occurrence.
2009	Cavallo *et al*	• Larger natural disasters negatively affect the per capita GDP both in long run and short run but small disasters have no output affect.
2010	Kim	• There exists a positive and statistically significant relationship between the growth rate and number of natural disasters. • There is no significant relationship between the investment to GDP ratio and any kind of disaster.
2010	Noy & Vu	• In terms of human capital disasters negatively affect the growth. • But in terms of capital destruction they are appear to boost the economy in Short period of time.
2011	Cavallo *et al*	• Only extremely large disasters have negative impact on output both in short and long run.

DATA SOURCE AND METHODOLOGICAL FRAMEWORK

Natural disasters results in high number of mortalities in Pakistan because most of the Population live in high-risk areas, infrastructure is constructed in adjacent to such areas, education and literacy levels are low, poverty is high, there are few social safety nets, there is little awareness either in government or among communities about how to mitigate disasters and how to prepare for dealing with them. The 2005 earthquake, for example, caused over 73,000 deaths, injured many more and rendered 3.3 million people homeless.

The study used Production Function (PF) analytical framework to estimate the loss in GDP attributable to Disasters related mortalities in Pakistan. The mathematical form of the production function is

$$Y = f(L, K, S, R, A, V) \quad (1)$$

Where:

Y = output,
L = labor (skilled, semiskilled and unskilled)
K = capital (equipment and inventories buildings)
S = land input (which encompasses all natural resources)
R = raw materials
A = efficiency parameter, measuring the entrepreneurial-organizational aspects of production
v = returns to scale

Thus, a production function shows the maximum amount of output that a country can produce with the different combinations of inputs with its existing resources and techniques. The gross domestic product (GDP) is one of the key measures of national output, which shows the monetary value of all goods and services produced within national geographic boundaries within specific time period is normally one year. It can also be considered a value of total consumption expenditure, gross private saving (business and personal savings) the net tax revenue (tax revenue less transfer payments and internal subsidies net of net interest paid) and total transfer payments made to foreigners. Intuitively, deaths related to disasters can affect the GDP in several ways, for example, they reduce the number of people involved in the production of output. Labor Force killed in natural disasters may be unskilled, semi-skilled labor and skilled labor force and entrepreneurs who are in acute shortage in Pakistan. The deaths of all categories of human resources can negatively affect the GDP of Pakistan. On the other hand output of the country possibly affected by the high funeral cost and disasters also force the people to sell their assets for the rehabilitation and reconstruction of the destroyed houses so depletion of the assets could spontaneously reduce the output.

Economies like Pakistan which already has high level of unemployment and low level of investments is potentially affected by the sudden shocks like disasters.

Given the high level of poverty in Pakistan the children may be forced to leave their schools due to lack of fees or to work in order to compensate for the deaths of earning hands and destruction of productive resources .This would have adverse impact on the future human capital creation and hence on the GDP and its growth rate. Permanent deaths of the active labor force may reduce the total consumption level of the household, personal and business savings, tax revenue of the government and hence resources available to the investment may be reduce. Disasters enforce individuals' government and other non government organization to divert the resources from the productive and development sectors to the reconstruction and rehabilitation programs which do not make any positive contribution to GDP of the country.

Formally, the effect of disasters related mortalities on GDP is expressed as follows:

$$GDP = f(D, L, K, HK, LE, OE, DS) \quad (1)$$

Where:

GDP = real per capita gross domestic product, i.e. real value of annual volume of goods and services divided by population.
D = land
L = labor input (persons aged 15 to 60 years)
K = physical capital stock.
LE = life expectancy.
HK = human capital, i.e. the skills and knowledge embodied in a person.
OE = openness of the economy (exports +imports)/GDP.
DS = number of people killed by disasters.

Equation (1) shows the effect of DS on GDP, holding the effects of D, L, K, HK and OE constant. If deaths caused by disasters are a burden on the economy of Pakistan the coefficient for DS variable would be expected to assume a negative sign. The effects of the explanatory variables on the dependent variable (GDP) are unlikely to be linear; thus, in this study we estimated Cobb-Douglas production function of the following form:

$$GDP = a\ D^{ß1}\ L^{ß2}\ K^{ß3}\ LE^{ß4}\ HK^{ß5}\ OE^{ß6}\ DS^{ß7}\ e \quad (2)$$

Taking the logarithms of both sides of equation (ii), we obtain the following double-log, or Constant elasticity model:

$$\text{Log GDP} = \log a + ß_1 \log D + ß_2 \log L + ß_3 \log K + ß_4 \log LE + ß_5 \log HK + ß_6 \log OE + ß_7 \log DS\ e \quad (3)$$

Where: log is the natural log (i.e. log to the base e, where e equals 2.718); a is the intercept term (i.e. the output if all the explanatory variables included in the model were equal to zero); β's are the coefficients of elasticity, which can take any value between 0 (perfectly inelastic) to ∞ (perfectly/infinitely elastic); and e is a random (stochastic) error term capturing all factors that affect gross domestic product but are not taken into account explicitly in the model

- Land" includes all natural resources such as soil, rivers, sea, lacks. Oil, forests and natural gas, etc. Agriculture is considered a backbone of Pakistan's economy, 70 percent of our population, either directly or indirectly associated with agriculture. We expect a positive relationship between the arable lands per capita GDP from agriculture contributes positively to the GDP.
- "Capital" indicates the stock of reproducible material resources such as plants and equipment, buildings, machinery, etc. development economists have argued that capital formation is one of the main determinants of the country's economic growth.
- The process of capital formation implies an increase in real savings in the country and existence of financial intermediaries to mobilize savings and divert them to productive sectors.
- There are several ways to increase capital formation, as
- Provide incentives for high savings at home
- Deficit financing and borrowing internal and external.
- Government may impose import duties and tariffs on imports of luxury goods.
- Remove underemployment in the agricultural sector by using the entire workers which have marginal productivity equal to zero, in development projects like construction of roads, railways, bridges, schools, hospital, etc.
- Promote foreign direct investment, where foreign investors come with technology and capital and the use of local labor in the production.
- Improve international trade conditions.

Since capital is acquired to boost production so that we expect direct positive relationship between capital formation and GDP per capita. Active population includes all economically active persons who are employed and seeking employment, but could not find a job for moment. Students, housewives and economically inactive people are not counted in the labor force. As we have high unemployment and underemployment in Pakistan and it is difficult to predict whether an increase in the labor force would results in an increase in GDP while the capital stock constant. "Human Capital" is productive investments embodied in human beings. These include values skills, technical expertise and health resulting from expenditures on education, vocational training and health care (including rehabilitation, care and preventive), it is the human resource of a nation (i.e. the quantity and quality of its work force) and not its physical capital or natural resources that ultimately determines the character and pace of its economic and social development. Unlike capital and natural resources, which are passive factors of production, human beings are active agents who accumulate capital, exploit natural resources in building social institutions, cultural, economic and political advance national development.

- We used gross university enrolment as a proxy of human capital in our study. As according to the previous studies there is direct relationship between the education attainment and earnings so we expect that it will positively affect the GDP.
- To capture the health related human capital we have used life expectancy at birth. Health consists of both health related quality of life as well as quantity of life. Since our study we are concerned with only disasters related mortalities, it made sense to include only life expectancy at birth. According to the World Bank there is strong evidence which shows that poor health imposes immense economic cost on individuals, household and society at large. Backer (1993) argued that a decline in the death rate at working ages may improve earnings prospects by extending the period during which earnings are received Ram (1985) found a positive relationship between life expectancy and real GDP per capita. Hence on the basis of previous arguments we predict positive effects of life expectancy on GDP per capita.

As no country can live in isolation in this global world so like others economy of Pakistan is an open economy. We have trade relation with the rest of the world and import as well as export goods and services we used ratio of exports plus imports to the GDP as measure of degree of openness in Pakistan.Net export means total exports to the rest of the world minus imports. We expect that net export is positively related to the per capita GDP in Pakistan.

The objective of this study is to estimate the loss of GDP due to disasters related deaths so it is obvious to include this variable. If disaster related deaths impose economic burden on our economy then its coefficient would be with negative sign. Table 4 shows the variable description which are used in the study.

Table 4 Variables description

GDP	Per capita gross domestic product (GDP), i.e. real value of annual volume of Goods and services (at 2000 constant price US dollar) divided by population.
D	Hectares of arable land per capita, i.e. total arable land divided by population
L	the number of people who are currently employed and people who are unemployed but seeking work, as well as first time job-seekers
K	Capital stock peroxide by gross domestic investment (as a percentage of GDP). It consists of additions to fixed assets of the economy plus net changes in inventory.
LE	Life expectancy in years.
OE	Openness of economy peroxide by ratio of import plus exports to the GDP
HK	Human capital is peroxide by the gross university enrolment.
DS	Number of people died in different natural disasters in a year.

The data used to estimate equation (3) is obtain from following sources. GDP per capita (GDP), arable land per capita (D) and labor force (L), life expectancy (LE), exports (X) and imports (M) from world development indicator (WDI), gross university enrolment (HK) and capital (K) or gross investment from the GoP (2011), while disaster related deaths (DS) from the International Emergency Disaster data base (EMDAT). We used ordinary least square technique for the statistical analysis of our data and time period of analysis ranges from 1975 to 2009.

RESULTS AND DISCUSSION

We used Production Function (PF) analytical Framework to estimate the loss in GDP attributable to disasters related mortalities in Pakistan so we test the production function whether it is constant rerun to scale increasing return to scale or decreasing return to scale. If doubling the inputs result in doubling the output then it is constant return to scale and if doubling the inputs results in output more than double then it is increasing return to scale and we say decreasing return to scale when output is less than double after doubling the inputs. Our model is given below

$$GDP = a \; D^{ß1} \; L^{ß2} \; K^{ß3} \; LE^{ß4} \; HK^{ß5} \; OE^{ß6} \; DS^{ß7} \; e \qquad (1)$$

The hypothesis are:

Null hypothesis: $\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 = 1$

Alternate hypothesis: $\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 \neq 1$

The result of F-statistics is 6.892 which are significant at 1 percent level. Therefore, we accept our hypothesis that production function is constant return to scale and no factor included in production function is redundant. The descriptive statistics are calculated and are presented in Table 5 for ready reference.

Table 5 Mean and standard deviation of the variables

Variable	Mean	Standard deviation
GDP per capita (constant 2000 US$)	468.190	110.604
Arable land	0.189	0.043
Disasters related deaths	2624.686	12550.537
Openness of the economy	19204507714	9004023453
Human capital	101317.448	80476.829
Gross investment	529721.257	204328.360
life expectancy	61.406	3.157
Labor force	35249189.54	10180623.06

Table 5 shows the mean and standard deviation of the untransformed values of dependent and independent variables. We have high average value of variable openness of the economy which is measured as import plus export ratio of GDP and this variable have high deviation from the average value. Arable land has minimum average value in all the variables and has less deviation from the central value. Table 6 shows some diagnostic statistics on the said function.

Table 6 shows the results of GDP per capita elasticity and slope coefficients. The coefficients of Labor force, arable land, and net export have negative sign while life expectancy, gross investment, human capital and disasters related deaths have positive sign and statistically significant at 1% level. Labor force and arable land have significantly negative impact on per capita GDP while openness of the economy is statistically insignificant. The coefficient beta measures the elasticity of per capita GDP with respect to each independent variable, that is percentage change in GDP for a given percentage change in the explanatory variable involved in study. For example elasticity of life expectancy is implying that one percent, on average increase in life expectancy increase the per capita GDP by 3.58 percent. As elasticity value of life expectancy is 3.58, which is greater than 1 in absolute term so we will say that it is elastic. If we look at the gross investment variable its elasticity value is 0.233 which means that one percent change in gross investment cause the 0.233 percent change in per capita GDP on average. The value of gross investment

is less than 1 so we can say that GDP per capita is inelastic, i.e. responsiveness to change in gross investment.

Table 6 Effects of explanatory variable on per capita GDP

Variables	Elasticity[1]	Slope coefficients	t-statistics	Probability
Arable land	-0.569	-2.062	-4.801*	0.0001
Disasters related deaths	0.0068	0.007	2.702*	0.012
Openness of the economy	-0.014	-0.004	-0.307	0.762
Human capital	0.096	0.052	2.537*	0.018
Gross investment	0.234	0.109	3.836*	0.0008
Life expectancy	3.581	5.324	4.438*	0.0002
Labor force	-0.775	-0.273	-3.877*	0.0007

11. Model criteria / Goodness of fit

R-squared	= 0.7794	Adjusted R-squared	= 0.7801
Durbin Watson	= 2.013662	F-statistics	= 6.892*

111. Diagnostic checking

ARCH test = 0.049 [0.825]; Normality test = 0.549 [0.759]; Ramsey RESET test = 1.235 [0.928]; serial correlation LM test = 0.046 [0.955]

Note: Average GDP per capita and those for individual explanatory variables are used in estimating the slope coefficients. * represent significant at 1% level.

The empirical results, given in Table 6, panel 11, appear to be very good in terms of the usual diagnostic statistics. The value of R^2 adjusted indicates that 78% variation in dependent variable has been explained by variations in independent variables. F value is higher than its critical value suggesting a good overall significance of the estimated model. Therefore, fitness of the model is acceptable empirically. The Durbin Watson Test shows that there is no problem of autocorrelation in the mode, as Durbin Watson value is around 2.

The robustness of the model has been presented in Table 6, panel 111, which has been definite by several diagnostic tests such as Breusch- Godfrey serial correlation LM test, ARCH test, Jacque-Bera normality test and Ramsey RESET specification test. All the tests disclosed that the model has the aspiration econometric properties, it has a correct functional form and the model's residuals are serially uncorrelated,

[1] Since elasticity is calculated by the expression
$\left|(\partial GDP \div \partial R_i) \times (\overline{R_i} \div \overline{GDP})\right|$
So we obtain the slope coefficients by the following formula:
$(GDP_i \div \overline{R_i}) \times \beta$
Where: Ri is ith explanatory (independent) variable; R bar is the average value of ith independent variable; GDP bar is the mean of Dependent variable, i.e. GDP; ß is the elasticity of log (DRD). For example, the slope coefficient for DRD was obtained as follows:
[(6.119705649 / 5.876131) × (0.006854)] = 0.00713

normally distributed and homoskedastic. Therefore, the outcomes reported are serially uncorrelated, normally distributed and homoskedastic. Hence, the results reported are valid for reliable interpretation.

Discussion

Slope Coefficient of disaster related deaths shows that increase in disaster related death by one person may increase the GDP by 0.007$ on average, which is the economic benefit from the single disasters related death. As population of Pakistan consists of huge no of unskilled or semi-skilled peoples and their contribution in GDP has been negligible normally they depend on the sole earning hand of their family. Here we are can say that people died in disaster are either unskilled or semi-skilled whose marginal contribution was negligible and their deaths affected the per capita GDP positively. The other reason of positive relationship of disasters related mortalities and per capita GDP can be from the labor theory which states that as number of the labor involved in production process increase with the fixed level of capital then marginal product will diminish. In our study we can say that as deaths occurred in natural disasters decrease the number of labor involved in production, then marginal product of the labor is increased which contributes towards the per capita GDP positively. We have negative coefficient of labor force which shows that one percent decrease in labor force will increase the per capita GDP by 0.27 percent. Labor force includes all the economically active people so who are currently working or seeking for jobs. Human capital is directly related with the per capita GDP, one percent increase in human capital increase the per capita GDP by 0.096 percent in Pakistan. Coefficient of arable land has negative sign which state that one percent increases in arable land decrease the per capita GDP by 0.569 percent on average. Results further show that one percent increase in life expectancy in Pakistan increased the per capita GDP on average by3.581 percent while coefficient of gross investment indicates that one percent increase in the per capita GDP by 0.234 percent.

As Pakistan received the huge amount of foreign add and financial assistance after the natural disasters so it gave opportunity to replace the old and obsolete technology. Infrastructure facilities improved and rural areas were more developed after the reconstruction and rehabilitation efforts made by government and non government organizations. All these factors exhibit the faster growth in per capita GDP of Pakistan following the disaster. Pakistan is an agriculture country and agriculture sector is the biggest employer of labor force. If we put a bird's eye view on the contribution of agriculture sector in GDP of Pakistan we can conclude easily that contribution of agriculture sector in GDP diminish over the time in Pakistan. Table 7 provides estimates of annual gain in GDP per capita due to single disaster related death.

Table 7 Annual per capita GDP gain due to one disaster related death[2]

Year	No of deaths	Annual GDP gain per death	Year	No of deaths	Annual GDP gain per death
1975	14	0.099933526	1993	931	6.645579479
1976	338	2.412680842	1994	440	3.14076796
1977	848	6.053116432	1995	1206	8.608559454
1978	393	2.805276837	1996	385	2.748171965
1979	113	0.806606317	1997	669	4.775394921
1980	93	0.663844137	1998	1392	9.936247728
1981	404	2.883796036	1999	816	5.824696944
1982	68	0.485391412	2000	349	2.491200041
1983	158	1.127821222	2001	306	2.184261354
1984	103	0.735225227	2002	312	2.227090008
1985	5	0.035690545	2003	699	4.989538191
1986	117	0.835158753	2004	274	1.955841866
1987	78	0.556772502	2005	74710	533.2881234
1988	486	3.469120974	2006	642	4.582665978
1989	305	2.177123245	2007	988	7.052451692
1990	551	3.933098059	2008	302	2.155708918
1991	1250	8.92263625	2009	244	1.741698596
1992	1875	13.38395438	Total	91864	655.7352452

In year 1985 we have minimum gain from per disaster related death which is 0.035690545$ on the other hand we have maximum gain from per disaster related death in2005 earth quake, in which total deaths were 74710 and gain to the GDP is $ 533.288.

CONCLUSION AND RECOMMENDATIONS

The objective of the study is to estimate the loss attributed to the per disaster related death in context of Pakistan from year 1975 to 2009. Literature found that disaster related deaths negatively affect the economy of the country. In our study, disaster related mortalities have positive contribution towards the per capita GDP of Pakistan. The result implies that disaster significantly increase foreign aid which ultimately increases economic growth of Pakistan. The study further calculated

[2] The formula use for finding the Annual per capita GDP gain due to one Disaster Related Death is as follows:
(AGG) = DRD × (GDPG) where DRD is disaster related death; AGG is annual GDP gain. GDPG is annual gain per disaster related deaths. For example for year 1977 annual GDP gain in Pakistan is 848 × 0.007138109 = $ 6.053116432

the annual GDP per capita gain for the year 1975-2009. The result concludes the following:

- There is a negative relationship between labor force and per capita GDP.
- Human capital is directly related with the per capita GDP while Coefficient of arable land has negative sign.
- Results showed that life expectancy and gross investment have positive relation with the per capita GDP.
- Finally human capital investment like health and education and gross investments in different sectors of the economy yield significant economic returns and strengthening the national capacity to minimize the impacts of natural disasters.

In order to minimize the number of deaths in different natural disasters following points should be considered in Pakistan.

- There should be proper institutions in Pakistan for handling the sudden situations like natural disasters.
- Many People die after the occurrence of natural disasters from different diseases. So government and other institution should take preventive measures to save the lives of the people from these diseases.
- Construction of the hoses and buildings should be much planned and in a manner that we face minimum lose of lives as a result of different natural disasters.
- Avoid the construction on the bank of the rivers and mountains. All the areas which are considered as a dangerous zone from the point of view of different natural disasters should not be used for the residential purposes.
- Hospital, educational institutes and all other public places should be constructed as disasters proof in dangerous areas.
- Scientists should concentrate to invent the different machines or instruments by which we can predict the natural disasters before their occurrence so that lives of the people can be saved easily by migrating them.
- Different institutions should create Awareness about the different impacts of natural disasters and how should people react in case of these sudden situations to minimize their direct cost.
- Education should be promoted because it is the best way to create awareness among the people to reduce the impacts of disasters.
- Foreign add which we receive in case of different natural disasters should be properly used for the reconstruction and rehabilitation purposes in Pakistan.

- Infrastructure facility should be improved so that in case of disaster government and other non government organization have easy access to help the people.
- Construction of the new of Dams can reduce the floods at some extent in Pakistan.
- There should be proper fund in the annual budget to handle any unpredictable and sudden situation in country.

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