

The relationship between uncertain disaster events and economic growth in the MENAP region

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Abstract—Uncertain disaster events plague human's life and environment. International community often seeks to alleviate this suffering through humanitarian aid. Do uncertain disasters also have negative effects on economic growth? The article deals with the notion of uncertainty in its applicability to economics. It considers the cases in which uncertainty is used, such as the technological and natural disasters. This article attempts to analysis this relationship in the MENAP region and it shows that uncertain (natural and technological) disasters on average have a negative association with economic growth.

Keywords— *disasters; economic growth; GMM method; uncertainty*

I. INTRODUCTION

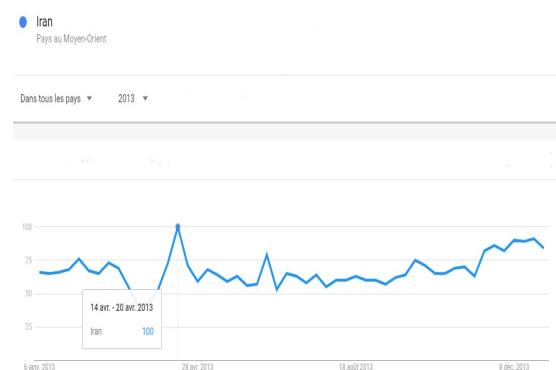
"On 9 April 2013 at 11:52 UTC (16:22 local time), an Mw 6.2 earthquake occurred at the depth of 20 Km in Dashti district in south-west Iran's Bushehr province" [1].

To refine our analysis of uncertain disaster events, we weight four examples of unexpected catastrophic events by the increase in Google trends by the search term of the name of the impacted

country in the days after the event compared to the days before the event.¹

For example, beginning by the figure below, we observe that Iran earthquake on 9 April 2013 have a great jump in coverage on the days in Google trends.

Fig. 1. The count of Google search by the word "Iran" in the days around (before and after) the 2013 earthquake event

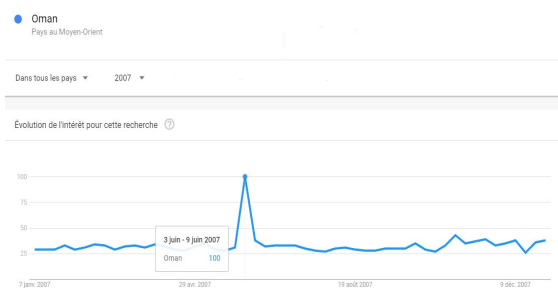


Source: trends.google.com

¹ "The results reflect the proportion of searches for a given keyword in a region and for a specific time period, relative to the region where the keyword's usage rate is highest (value of 100). Thus, a value of 50 means that the keyword was used half as often in the region, and a value of 0 means that the data for that keyword is insufficient." (trends.google.com)

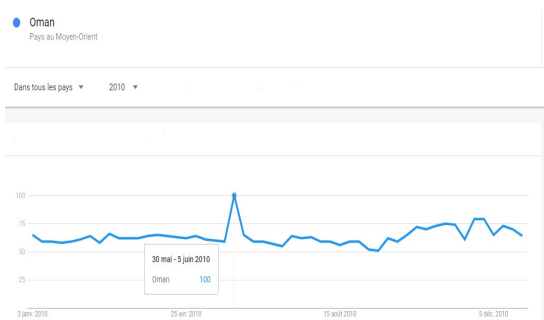
As well, figures 2 and 3, show also a great jump in coverage on the days of Oman disasters occur (Gonu in 3 June 2007² and Phet in 5 June 2010³).

Fig. 2. The count of google search by the word "Oman" in the days around (before and after) the 2007 Gonu event



Source: trends.google.com

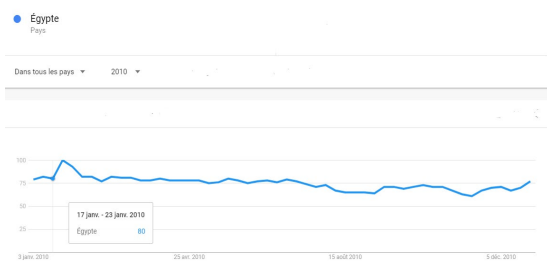
Fig. 3. The count of Google search by the word "Oman" in the days around (before and after) the 2010 Phet event



Source: trends.google.com

Furthermore, the Egypt flood in 17 and 18 January 2010 was a surprise event as shown in figure 4.

Fig. 4. The count of Google search by the word "Egypt" in the days around (before and after) the 2010 flood event



Source: trends.google.com

Uncertain disasters can be classified into two types. Firstly, natural disasters such as: earthquakes, tsunamis, volcanic eruptions, extreme temperatures, floods and wildfires droughts.

Secondly, technological disasters such as: Transport, Industrial and Miscellaneous accidents. Therefore, the uncertain disaster is an event⁴ that has catastrophic effects and consequences.

The effects of uncertain disasters are depending on the sort of disaster but all uncertain disasters will cause both long-term and short-term effects on the environment and humans. Long-term and short-term effects have both direct damage which is the material losses and the indirect damages, which are considered the loss of production of goods and services.

Short-term effects have caused high demands for resources that are extremely hard to meet and will increase the number of hospital visits due to illnesses and injuries for example with earthquakes and also transport accidents can cause a great deal of injuries that require immediate care from health facilities however since, uncertain disasters occur without warning facilities are oftentimes unprepared for the effects of the uncertain disaster.

Long-term effects of uncertain disasters again they have the direct damage and indirect damage, they also are focusing on restoring the area back to normal working function in the case of an earthquake health care facilities are now addressing permanent disabilities also depending on the type of uncertain disaster in the strength of the economy. Uncertain disasters can cost billions of dollars. The long-term effects also include damages to the infrastructure of an area for example the damage done to houses, buildings, the water and sewage systems and those things can take a long time to recover from a uncertain disaster. So, the uncertain disaster events affect human's life and environment, this raises the question of whether disasters affect also the country's economy.

This article addresses the impact of uncertain shocks that is natural and technological disasters on the economic growth in the MENAP region. It has three contributions to the literature. Firstly, we pioneer to estimate the country-level disaster impacts by the GMM method, with the MENAP region, that efficiently accounts for measurement errors and endogeneity that can otherwise be problematic in country growth models. Secondly, we use the event indicator of disasters for two reasons. Firstly, an important and remarkable distinction is that among what we can call loss

² Cyclone Gonu is the strongest powerful cyclone hits beaches on the Arabian Sea in nearly 60 years, according to meteorologists. (wikipedia)

³ Hurricane Phet is a powerful fourth-class hurricane hit the coast of Oman on June 5, 2010 and it put pressure on transportation, health and economy (wikipedia)

⁴ Force of nature or harmful event.

indicators and event indicators which we have chosen in our study.

The loss indicators disasters capture the disaster damages as a part of total GDP and the reported number of killed or affected as a part of total population. The use of loss indicators could reflect non-linearities in the true effects and these indicators have an endogeneity problem.

The use of loss indicators could reflect non-linearities in the true effects and these indicators have an endogeneity problem through a regular lack of reporting; underreporting is an obvious problem in the EM-DAT data⁵. It cannot be that there are disasters with zero damages, but that there is a lot of missing information in this database.

Data can be missing for the two simple reasons that no one really knows the amount of damages or the number of deaths and injuries. Another reason is deliberate over reporting. We can consider the Haitian earthquake in 2010 as an example when news agencies have reported on a draft report commissioned by the United States Government concluding that there may have been deliberate over reporting. Furthermore, governments exaggerate damages in order to attract more humanitarian aid [2].

The event indicators capture the incidence and reflect the number of reported events of all types of disasters. The event indicators are clearly less problematic in this respect than are the loss indicators.

Thirdly, our analysis not only limited to natural disasters as in most research, we include both natural and technological disasters.

The remainder of the article is structured as follows: Section 2 reviews the literature on the impacts of disasters on economic growth. We present the data and methodology in section 3, while Section 4 shows and discusses the empirical results. Finally, concluding remarks are given in section 5.

II. LITERATURE REVIEW

"Large natural disasters (LNDs) are ubiquitous phenomena with potentially large impacts on the infrastructure and population of countries and on their economic activity in general" [3].

"Compared to the vast amount of research done in natural sciences and other social sciences, economic research on disasters and their

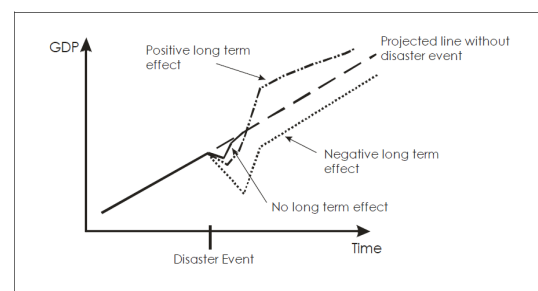
consequences is fairly limited" [4]. So, the economics of uncertain disasters is a nascent field.

The literature on the economic effects of disasters can be categorized into studies looking into the short-to-medium term like and the longer term.

In this article we examine the effects of uncertain disasters on long-run economic growth in the MENAP region.

Fig. 5 shows that there are three possible trajectories of GDP after an uncertain disaster; no long term effect, positive effect or negative effect.

Fig. 5. Possible trajectories of GDP after a disaster



Source: [7]

The results of researches are differed from one to another. [8] Compared GDP growth rates before and after 28 major natural disasters and he found that the uncertain disasters have no effects on economic growth.

Ref. [9] fails to find a negative relationship among natural disasters and economic growth.

Ref. [10] using standard cross-sectional ordinary least squares technique, examine the long-run relationships among disasters, total factor productivity, capital accumulation and economic growth and they find that "higher frequencies of climatic disasters are correlated with higher rates of human capital accumulation, increases in total factor productivity, and economic growth. Though disaster risk reduces the expected rate of return to physical capital, risk also serves to increase the relative return to human capital. Thus, physical capital investment may fall, but there is also a substitution toward human capital investment. Disasters also provide the impetus to update the capital stock and adopt new technologies, leading to improvements in total factor productivity."

Others like [11] and [12] found that disasters are setbacks and obstacles for economic growth.

Ref. [13] using a cross-country sample during the period 1970-2002, finds that "natural disasters lead to a median reduction of 2.2 percent in the

⁵ EM-DAT (2017) : The international disasters database

same-year real GDP growth, and that they increase the current account deficit and public debt".

Ref. [14] used panel of five-year country level data, they found a negative correlation between disaster effects and the long-run economic growth rate.

Ref. [15] used panel vector autoregression techniques and he founds that "in the long run, a climate related disaster is linked to reductions in real GDP per capita by at least 0.6 percent".

Ref. [16] uses the value of the magnitude if an earthquake occurred and a dummy variable for if a windstorm occurred. His study revealed that "After Hurricane Mitch struck Honduras in 1998; there was severe unemployment in urban areas since the disaster damaged private capital and key infrastructure, negatively affecting aggregate labor productivity".

As well, [17] used disasters in which the number of killed plus 0.3 times the number affected amounts to more than 0.01 percent of the population and they found a negative correlation among disasters and economic growth.

Ref. [18], using Hausman-Taylor random effects and loss indicators (mainly damages) as a fraction of GDP, he found negative effects on economic growth.

Ref. [19] used a panel of 36 years of data and 113 countries. He examined "the relationship between different measures of natural disaster impact and long-run economic growth". The results of his study show that "for some of the groups of countries the disaster impact persists beyond the 2-5 years in which reconstruction and adaptation are expected to have an effect on the economy".

Ref. [20] use the annual number affected and killed from natural disasters as disaster's indicator and they found that natural disasters are negatively correlated with the economic growth.

Surprisingly however, many others find a positive effect. For instance, using the Solow-Swan model [17] found a positive effect of earthquakes (and also storms) on industrial growth. In the empirical results of their study we found that "floods carry a significant coefficient, indicates a positive effect of floods on services output growth".

Ref. [21] found a positive and statistically significant relationship between (climatic and geologic) disasters and the growth rate during the period 1960-1990. I also found a similar relationship between the disaster frequencies and growth rate during the period (1990-2004).

We observe that studies are used often the loss indicators such as total deaths, injured, homeless and damages and also, there is clearly a lack of consensus about the most appropriate econometric method and the studies range from different techniques.

So, we observe that any study using the loss indicators would bring into the empirical analysis would be instances of missing data, rather than true zeros. This motivates the use of event indicators because it will be less serious than if loss indicators were used.

III. DATA AND METHODOLOGY :

A. Data

1) Sample construction

The table below presents the sample of countries included for our analysis on the relationship between disasters events and economic growth over the period 2004–2017.

TABLE I. SAMPLE COUNTRIES

Algeria	Kuwait	Sudan
Afghanistan	Lebanon	Syria
Bahrain	Libya	Pakistan
Egypt	Morocco	Tunisia
Iran	Oman	United Arab
Iraq	Qatar	Emirates
Jordan	Saudi Arabia	West Bank and
		Gaza
		Yemen

2) Variables description

All data except the data on disasters are from World Bank's World Development Indicators, WDI, (2019).

a) Dependent variable

The dependent variable is the growth rate of real per capita Gross Domestic Product (CGDP). It is used as a proxy for global economic development. "It is a measure of the total output of a country that takes the gross domestic product (GDP) and divides it by the number of people in the country".⁶

GDP per capita shows the relative performance of countries and it also has an impact on the application and reserves of deposits and loans.

"Annual percentage rate of GDP per capita growth based on constant local currency. GDP at buyers' prices is the sum of the gross value added of all resident producers in an economy plus all taxes

⁶ See (© 2019 Quizlet Inc)

on products and minus subsidies not included in the value of products." WDI (2017)⁷

b) Independent variable

Our main independent variable is disasters indicator; which is measured by the number of disasters incidents.

The data for the disasters events are taken from the EM-DAT (2010) database. In this field, an absolute majority of the studies use this database as their primary source of data.

EM-DAT database provide a comprehensive and standardized list of large-scale disasters with the aim of helping policy-makers, researchers, and aid workers better respond to future events [22].

c) Control variables

The study controls for several variables that impact economic growth. With the uncertain disasters which are the main determinants of economic growth in our study we use:

- The consumer price index (CPI) inflation rate which measures macroeconomic stabilization (with bad macroeconomic policies being associated with high inflation). The consumer price index (CPI) inflation rate reflect the annual percentage change in the cost to the average consumer of acquiring a basket of services and goods that can be changed or set at specified intervals [23].

- Financial depth is measured by the ratio of domestic credit to private sector supplied by private financial institutions to GDP. (WDI, 2019)

Following prior evidence: "All these control variables are assumed to be either predetermined (independent of current disturbances, but they may be influenced by past ones) or endogenous and thus correlated with current realizations of the error term, one of the main reasons for using the GMM procedure outlined above" [17].

B. Methodology:

We will employ a dynamic panel model, based on a Generalized Method of Moment (GMM) estimator developed by [24] to study the relationship between uncertain disaster events and economic growth in 21 MENAP countries over the period 2004-2017.

Our model choice of a GMM in dynamic panel is based on two premises. First, the GMM estimation provides efficient estimate by allowing to control for specific effects individual and temporal and to overcome any potential

endogeneity bias of the variables. Second, there exists an ample of prominent literature on the impact of other exogenous chocks on economics that employ the GMM estimator. For instance, studies on relationship between financial stability and economic performance [25], and other examines the impacts of political instability, tourism and energy consumption on economic growth in the MENA countries using a dynamic GMM and static panel data approach [26].

Ref. [27] has a high concentrated of the relationship between terrorism and FDI in the EU and EEA countries.

The model used to estimate the relationship between disasters events and economic growth is as below:

$$f(LNTD_{t-1}, DCPS_t, CPINF_t) = CGDP_{c,t} \quad (1)$$

The econometrical model is the following:

$$\alpha_0 + \beta_1 LNTOTALD_{c,t-1} + \beta_2 DCPS_{c,t} + \beta_3 CPINF_{c,t} + \xi_{c,t} = CGDP_{c,t} \quad (2)$$

Where CGDP is the economic growth index, LNTD is the disasters index, DCPS is the ratio of domestic credit to private sector and INF is the consumer price index (CPI) inflation, α and β are coefficients to estimate, and ξ is the error term.

IV. EMPIRICAL ANALYSIS

A. Preliminary data analysis

1) Descriptive Statistics

The statistical results obtained from the Table II, concerning the summary statistics of the variables employed in the analysis, show that during the period 2004–2017: There are 294 observations for each variable.

On average, the economic growth proxy rate is approximately 1.409485. The minimum is approximately -62.22509, while the maximum is approximately 122.9683. The sub-samples in Table 2 show that at the mean, the group of technological disasters has 0.7340673, while the minimum is 0 and the maximum is approximately 3.433987. The group of natural disasters has at the mean 0.5702375 while the minimum is also 0 and the maximum is 2.70805.

The descriptive statistics show that at the mean, the group of total disasters has 1.043363 with minimum equal to 0 and maximum equal to 3.555348.

⁷ World Development Indicators

Finally, our both control variables (CPINF and DCPS) have respectively at the mean 7.07364 and 41.31821.

TABLE II. DESCRIPTIVE STATISTICS

Variables	Obs	Mean	Std.Dev	Min	Max
CGDP	294	1.409485	9.92957	-62.22509	122.9683
LNTOTALD	294	1.043363	0.8999799	0	3.555348
LNTD	294	0.7340673	0.7737248	0	3.433987
LNND	294	0.5702375	0.707652	0	2.70805
CPINF	294	7.07364	8.261967	-6.811161	53.24779
DCPS	294	41.31821	27.47468	2.68222	107.246

Provided by: Stata11

1) Correlation

The correlation coefficients are in table III. The coefficients of the independent variable do not suggest any problems of multicollinearity in our study.

Table III indicates a correlation of 0.4510 between natural disasters and technological disasters. To isolate the effects of each disaster, the two disaster measures are included simultaneously in the regressions.

TABLE III. CORRELATION MATRIX

CGDP LNTD LNND LNTOTALD CPINF DCPS

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CGDP      1.0000
LNTD      0.0710 1.0000
LNND      0.0693 0.4510 1.0000
LNTOTALD  0.0776 0.8857 0.7807 1.0000
CPINF     0.0304 0.2919 0.1918 0.2814 1.0000
DCPS     -0.1323 -0.3319 -0.4209 -0.4599 -0.3466 1.0000
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Provided by: Stata11

B. Empirical evidence

Generalized Method of Moments (GMM) is the most widely adopted method to work around the problems of traditional estimators and get a better estimate. It also corrects the selection bias in addition to taking into account omitted variables and reverses causality. It has the advantage of taking into account the possible endogenousness of

the variables by using internal instruments. These instruments in our estimation will be the lagged values of the GDP variable and the variables explanatory ratio of domestic credit to private sector and consumer price index (CPI) inflation rate.

The GMM consists in taking for each period the first difference of the equation to be estimated in order to eliminate the individual specific measures and effects an unbiased estimation [[28] and [29]] make it possible to solve the problems of causality inverse, simultaneity, and omitted variables.

The main results of the relationship between uncertain disasters (natural disasters, technological disasters and total disasters) and economic growth are shown in the tables below.

The table below presents the GMM estimation with total disasters which is logarithm of 1+ number of total disaster events (natural plus technological), for the period 2004-2017. The table shows that the total disasters have a negative and statistically significant impact on economic growth.

TABLE IV. GMM ESTIMATION RESULTS OF THE IMPACT OF TOTAL DISASTERS ON ECONOMIC GROWTH

	Notation	Coefficient	P_value
Dependent variable	CGDP	-0.3451507	0.000*
Independent variable	LNTOTALD	0.9354387	0.000*
Control variables	CPINF	0.0417621	0.000*
	DCPS	-0.1067634	0.000*

*Significant at the 1% level. **Significant at the 5% level. ***Significant at the 10% level.

Provided by: Stata11

We observe that the technological disasters have also a negative and statistically significant impact to long-term economic growth.

TABLE V. GMM ESTIMATION RESULTS OF THE IMPACT OF TECHNOLOGICAL DISASTERS ON ECONOMIC GROWTH

	Notation	Coefficient	P_value
Dependent variable	CGDP	-0.342707	0.000*
Independent variable	LNTD	0.5035074	0.000*
Control variables	CPINF	0.0330553	0.001*
	DCPS	-0.1026696	0.000*

*Significant at the 1% level. **Significant at the 5% level. ***Significant at the 10% level.

Provided by: Stata11

In the results of our estimation of the impact of natural disasters on economic growth are shown in the following table:

TABLE VI. GMM ESTIMATION RESULTS OF THE IMPACT OF NATURAL DISASTERS ON ECONOMIC GROWTH

	Notation	Coefficient	P_value
Dependent variable	CGDP	-0.3538081	0.000*
Independent variable	LNND	2.897308	0.000*
Control variables	CPINF	0.0260805	0.091*
	DCPS	-0.0791811	0.000*

*Significant at the 1% level. **Significant at the 5% level.
***Significant at the 10% level.

Provided by: Stata11

The impact of natural disasters is clearly negative and statistically significant on economic growth. This result corroborates that of some similar studies like [30].

The results of our estimation show that the coefficients of the three disaster variables are expected and very significant. In our three estimations, the ratio of domestic credit to private sector and the consumer price index (CPI) inflation rate have the same impact on the economic growth.

The consumer price index (CPI) inflation rate has a negative and statistically significant impact on economic growth. This suggests that an increase in the inflation rate is unfavorable to the improvement of economic growth. This result confirms with some previous work; for example, [31].

A low level of financial depth involved that economic growth are lowing in our study period.

V. CONCLUSIONS AND POLICY IMPLICATIONS

Over the last two decades, there has been a steady increase in the incidence of terrible disasters, especially in already poor countries like MENAP region. Thousands die every year in natural disasters, and large amounts of physical capital are also destroyed in technological disasters. We know that the international community often seeks to help disaster victims by sending humanitarian aid. It is worth asking whether more aid can also be stimulated by referring to the effects of the negative growth of disasters on the economy. As we have drawn from the results of this study.

Several studies have negative effects, but others have not reported any effects or even positive effects of disasters on growth.

In this paper, we tried to provide better evidence of the effects of disasters on the economic growth to inform policy makers of the benefits of disaster risk reduction and mitigation because literature to date is inconclusive with regard to the effects of disasters on growth.

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