A Closer Look at Economic Impacts of Natural Disasters on Growth

Jacob Medina

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Masters Candidate at California State University, Long Beach

Abstract

This paper analyzes the interaction between natural disasters, government institutional quality and economic growth. A standard growth regression model is estimated using a new dataset combining natural disaster and macroeconomic characteristics. I find that natural disasters have a negative and significant impact on economic growth, but that negative effect lessens as government institutional quality increases.

Keywords: Natural disasters, Institutional quality, Economic growth

JEL Codes: F43 O47 Q54 Q56

1. Introduction

The economic impacts of natural disasters are of growing interest, especially with the recent hurricanes striking the coasts of Texas, Florida, and causing destruction to the small islands in the Atlantic Ocean. Texas and Florida, which are two of the largest state economies in the United States (U.S.), are expecting high renovation costs, as well as a humanitarian situation to aid its citizens. Hurricanes Harvey (Texas, Louisiana), Irma (Florida), and Maria (Puerto Rico) have an estimated $365 billion dollars of damages from these three hurricanes to four states, making these the costliest in U.S. history (Amadeo 2017). What would happen if these same hurricanes hit poor countries, with less access to recovery funds, and with weaker institutions in which to respond to mitigate damages? When natural disasters cause harm to countries natural resources, capital stock, infrastructure, and citizens it is up to the government institutions to develop a response to take care of these unfortunate situations. The ideal response is to take care of everyone's needs and make sure they are safe and secure, but not all countries (if any) can have the ideal response without deterring from their current fiscal plan. Most countries fluctuate in the quality of government, recipient of aid, reserve funds, and technology to repair when struck by natural disaster shocks allowing for countries to be affected in separate ways.

Some issues with natural disaster research is that the data is too heavily reliant on the Emergency Events Database (EM-DAT), which is controlled by the Centre for Research on the Epidemiology of Disasters (CRED). Being the main source of data, researchers are limited to the same data sources leading to mixed results once they change their econometric specification, such as Schumacher and Strobl (2011), Felbermayer and Groschl (2014), and Noy and Vu (2010). Previous literature has set out to discover the true effects natural disasters have on

economic growth, but with a repeated dataset any minor changes to specifications or different econometric models create mixed results which lead researchers to argue that natural disasters may have a negligible effect on growth since the country will devote resources to preventing such disasters from causing a lot of harm by increasing research and development, which in the long-run increases economic growth and the country's infrastructure.

The purpose of this paper is to estimate the impact of natural disasters on economic growth. I extend the current literature by employing a new dataset and analyzing how institutional quality plays a role in determining the magnitude and direction of that impact. I use the natural disaster dataset, Geological and Meteorological Events Database (GAME), which combines a reconstructed dataset from existing literature and the Quality of Government (QoG) dataset to see how my results match up to previous authors. I interact the disaster index with a new measurement for quality of government to see how the quality of government impacts economic growth. My results find that when natural disasters occur in a country, there is a negative and significant impact on economic growth. With the quality of government variable added to the econometric specification, I find a positive and statistically significant relationship with economic growth, but when interacted, there is a positive outcome for the impact on economic growth leading me to believe that a higher quality institution alleviates the negative impact of natural disasters.

2. Literature Review

The empirical growth literature remains an active and debatable topic for macroeconomist today. The determinants of economic growth are varied and difficult to quantify which leads to the much-needed focus on this topic of research. With the sudden increase in hurricanes, floods, storms, and earthquakes that have devastated Mexico, the United States,

especially Puerto Rico, and the small islands in the Atlantic Ocean it is safe to assume that these natural disasters will have a negative impact on their economies. This paper will delve into the economic impacts that natural disasters have on countries economic growth by exploring characteristics of natural disasters, economic growth, and country specific characteristics to help identify the impact.

Shabnam (2014) uses the severity of natural disasters to control for the impact on economic growth by focusing on the total number of deaths and people affected during floods. His paper shows that as the number of people affected or killed during floods, the immediate impact of GDP per capita growth is negatively and significantly impacted. This paper seems to clarify the trend in natural disaster literature because with expected monetary values of recovery, potentially, reaching to upwards of hundreds of millions of dollars in repairs to infrastructure and aid to citizens, this loss to productivity can reduce the country's economic growth. As expected, natural disasters should have a negative impact on economic growth, but some papers have found conflicting results.

A few meta-analysis regression papers have been done to deviate from previous literature to see if they can find a conclusive effect of natural disasters on growth, but their research found that natural disasters may only have a negative impact in the short-run, but return to its normal growth rate in the long-run (Klomp and Valckx 2014). Lazzaroni and van Bergeijk (2014) also find inconclusive evidence on natural disasters as they find that the average of 64 papers have a negative impact when it comes to direct costs, and insignificant indirect costs. Past estimates of the effects natural disasters have on economic growth have been mixed (Loayza et al. 2012). With some authors arguing that severe disasters will have a negative impact and moderate disasters can produce positive growth (Fomby et al. 2013). Hallegate and Dumas (2009) argue

that natural disasters can improve technology, which improves productivity in countries leading to a long-term increase in economic growth. Hallegate and Dumas discover that there may be some immediate loss GDP, but countries rebuild and enhance previous infrastructure and improve technology to see a small positive change, but not significantly. Loayza et al. (2012) find that although there is still a loss to growth in some countries, not all of them are negative. Moderate disasters can have a positive impact on growth, where more severe disasters are negatively impacting. The authors also find that the impact varies across countries and economic sectors, with developing countries and agricultural sectors being most sensitive. Strobl (2012) estimates the effects of hurricanes on economic growth, and finds that hurricanes have a small negative impact on economic growth, stating he could not find the local effects, only aggregate, as he did not have any local income data.

Noy (2009) takes natural disaster literature one step further and looks at the individual impacts of the determinants of growth. This paper discovers that the amount of damage has a negative impact on GDP per capita, but also has a negative impact on institutions. Government institutions must reallocate funds to help the citizens who have unfortunately suffered from a natural disaster. Foreign aid can help countries recover more quickly, but if the institutions suffer from corruption there could be misallocation of funds making matters worse for that country in their time of need (Felbermayr and Gröschl 2014). Although the governments of these countries may have high investment spending they are burdened with an increase in government spending to repair roads, infrastructure, and provide medical supplies. If these countries suffer from low levels of corruption, meaning the funds were properly allocated, there will be little to no effect on growth, but if the country suffers from high levels of corruption there will be a noticeable negative impact on growth (d'Agostino, et. al 2016). Barone and Mocetti (2014) find that pre-

quake governments with less corruption have a better chance at making up for the negative impact that natural disasters have on growth.

The inconsistent results regarding economic growth and natural disasters may be due to data availability. Most papers use the EM-DAT which is responsible for cataloging emergency events at the international level. This dataset contains more than 22,000 mass disasters from the 1900s to present day, currently CRED manages the database. The likelihood of this database being used for this area of research is very high. A new dataset was compiled by Centre for Economic Studies (CES) institute which introduces a more in depth look at the characteristics of natural disaster data. GAME dataset provides researchers more data and characteristics to work with when analyzing the impact of natural disasters. The GAME dataset provides new insights on what impacts natural disasters have on economic growth. Although the topic of economic growth is extensively discussed, the literature on natural disasters and growth tends to be thin. With majority of natural disaster and economic growth research being theoretical, there has been conflicting results with the use of numerous econometric approaches, with most practices applied to several aspects of growth. This paper expands on existing literature by examining the effects of natural disasters on economic growth by combining the GAME dataset and QoG dataset. Additionally, I plan to explain how the quality of government play a role in economic growth by interacting it with the natural disaster variable.

3. Econometric Specification

3.1 Theoretical Model

According to the Solow growth model, economic growth is determined by technological advancement, capital stock, labor force, and institutions. With the occurrence of a natural disaster, I expect a negative impact on economic growth. Like civil conflicts, natural disasters act

as a resource shock that reduce human capital and the stock of physical capital by damaging the existing advancements which restrict those improvements and slows down their rate of convergence to the steady state. The Solow growth theory also states that institutional quality can help aid or hurt economic growth, meaning a country with higher quality institutions will most likely reallocate funds in a more appropriate manner, where a corrupt, low quality government may not. The importance of institutions is a cornerstone to how funds get allocated, and thus with a corrupt institution you are more likely to misallocate funds and slow down the recovery process.

Natural disasters in the EM-DAT databases are typically recorded for three reasons, (i) 10 or more people are confirmed as killed (ii) 100 or more people are affected and (iii) declaration of a state of emergency or call for international assistance (Guha-Sapir et. al 2009). Natural disasters have the strength to destroy power lines, restrict access to medical supplies, and pummel infrastructure requiring maintenance and repair costs. With the expected costs of repair in the hundreds of billions of dollars, the United States will increase its spending and must reallocate funds to cover those costs. This means funds could be removed from education, infrastructure could be damaged and in need of repair, and with a fiscally conservative government, hurricanes Harvey, Irma, and Maria could slow down economic growth for the US, by forcing the US to pull from other programs to cover the costs of recovery.

3.2 Empirical Method

I estimate the following growth regressions:

$$\ln Y_{i,t} - \ln Y_{i,t-5} = \beta_0 + \beta_1 D_{i,t} + \beta_2 X_{i,t-5} + \phi_i + \gamma_t + \epsilon_{it} \quad (1)$$

$$\ln Y_{i,t} - \ln Y_{i,t-5} = \beta_0 + \beta_1 D_{i,t} + \beta_2 G_{i,t-5} + \beta_3 X_{i,t-5} + \beta_3 D_{i,t} \times G_{i,t-5} + \phi_i + \gamma_t + \epsilon_{it} \quad (2)$$

These regressions are made up of a composition of equations that are repeated with fixed effects to show the evolution of the regressions and the justification for using time and country fixed effects. In equation (1), this is what previous literature has used to estimate the impact of natural disasters on economic growth. Previous literature focuses primarily on the characteristics of natural disaster and how different wind speeds, precipitation, Richter scales, and size of earthquakes impact economic growth. Equation (2) shows my added institutional quality variable, and the interaction between institutional quality and natural disaster. The dependent variable is the growth rate of real GDP per capita purchasing power parity, $D_{i,t}$ is the natural disaster specific variable, $X_{i,t-5}$ are the control variables for the dependent variable, γ_t and ϕ_i as the country and time variables, and the last term $D_{i,t} \times G_{i,t-5}$ is the interaction of natural disasters and institutional quality.

3.4 Data

I use the GAME dataset of natural disasters constructed by Felbermayr and Groschl (2014). The GAME dataset incorporates data from over 10 different sources such as Incorporated Institute for Seismology (IRIS), Volcanic Explosivity Index (VEI), National Climatic Data Center of the National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), to name a few. When combined with the already strong EM-DAT and CRED data, the GAME dataset provides for more variety in natural disaster specific variables. The GAME dataset is maintained by the CES institute and is responsible for maintaining and correcting any errors that authors may find in their dataset. The GAME dataset is a country-level database that covers natural disasters from 1979 to 2010, which collects information on geological and meteorological events. Furthering the data, I have decided to merge the GAME dataset with data from QoG institute, which was founded in 2004. The QoG

institute is a group of thirty researchers based out of Sweden that gather macroeconomic specific characteristics on a wide variety of countries. With a lot of overlap with data sources, the QoG provides more accurate data for control variables as well as growth specific variables that benefit my research.

I use an unbalanced panel of 1,624 observations with 203 countries throughout my entire sample and I restrict my sample from 1975 - 2010. Each panel is a five-year period, and the reasoning for this is because five-year panels seemed to be the most reasonable selection since three-year panels would have been too short of time of variation effects to see the impact of natural disasters, and ten-year panels would be too long.

Table 2 provides summary statistics of my panel regressions. The growth rate is calculated by taking the difference of the five years forward value subtracted by the original value for real GDP. The disaster index includes the sums of all types of disasters, meaning that this is the sum of earthquakes, storms, floods, and extreme weather events that occurred in the country. I used this as my variable of interest to capture the overall effect of natural disasters instead of looking at individual, or specific types of disasters. Additionally, this variable has been normalized to have a standard deviation of 1 and a mean of 0. The quality of government variable is defined as the mean value of three different measures of corruption, law and order, and bureaucracy quality. The three different measures are all on a scale of one to six and the mean value of the total sum are then normalized to a zero to one scale, meaning the quality of your government increases the closer you are to one. The first measure, corruption, is the demand for special payments and bribes connected with imports and export licenses, exchange controls, tax assessments, police protection, or loans. Additionally, the International Country Risk Guide (ICRG) consider more serious forms of corruption by accounting for excessive

patronage, and secret party funding, to name a few. Law and order are assessed separately, but are comprised of two sub-sections of zero to three points, totaling for six points. The Law sub-section consists of an assessment of the strength of the legal system, where the Order sub-section is an assessment of observance of the law. Lastly, the bureaucracy quality variable is given points by their ability to govern. Foreign direct investment is the net inflows of direct investment from non-domestic parties and is measured by the percent of GDP for the total investment. Trade openness is measured by summing the imports and exports, then dividing by GDP to show the level of trade a country does. Domestic credit is the amount of domestic credit that is provided by the banking sector along with current account balance being shares of GDP. The polity variable is taken from the Polity IV Project, and is normalized to a min and max of 0 and 1, with the higher the value being more democratic and the lower being more autocratic.

Table 2 shows the summary statistics of my fixed effects regressions. Within those regressions, there are a reported 526 observations and 106 countries, but only 413 observations and 96 countries with the addition of the quality of government variable since it has less coverage than the other variables. With a mean average of 0.63 for the polity index, meaning that of these 106 countries, there were a majority who saw themselves as democratic, but when compared to the quality of government there was a reported mean value of .58 for quality of government. I find this interesting because with the average value being 0.63 for polity, this means that most countries had average quality governments. With high standard deviations, this means there were a lot of variations throughout the countries with government quality and democracy level. Another interesting result is that the average five-year growth rate shows a positive 0.04 with standard deviation of 0.03. Having a positive mean value is expected since I am looking at averages of five years.

4. Results

4.1 Baseline Results

Table 3 provides the results for model (1). Column (1) shows the base OLS model with time effects, and as I have mentioned earlier about the mixed results, the changes in specifications from columns (1) and (2) show two separate measures. Column (1) shows that there will be an increase in growth by 0.49 percent with a one-unit standard deviation change in natural disasters leading to a statistically significant result to the one percent level. This result supports the mixed results literature as they argue that when disasters happen, and as I look at it aggregately, there could be a positive outcome. This positive impact could be due to countries improving infrastructure because of the disasters occurrence leading to long-term economic growth. Moving to column (2) I add more justification to my model by including time fixed effects and country fixed effects into my regression. Column (2) applies fixed effects to the regression to control for the characteristics that may be time invariant, but vary across countries. With added fixed effects into the regression, my results show that with a one-unit increase in the standard deviation of disasters, there will be statistically significant decrease to the one percent level of a 0.90 percent decrease in economic growth, this result however is more in line with previous literature as it shows that looking at natural disasters aggregately will have a negative and statistically significant impact on economic growth.

4.2 Quality of Government Results

Table 4 presents the results of model (2) which includes the quality of government and its interaction with natural disasters. Table 4 demonstrates my contribution to the literature by adding the quality of government variable into the econometric specification. Table 4 column (1) continues the trend of getting mixed results, and the justification for fixed effects included into

regressions. Column (1) shows the simple OLS regression, and states that as natural disasters occur, there will be a statistically significant increase in economic growth by 0.42 percent with a one-unit change in the standard deviation. Also, it states that the quality of your government will increase economic growth by roughly 1.4 percent for every one-unit change in your government quality, but is statistically insignificant. Column (2) shows the OLS regression with the interaction term included. Column (2) finds that as natural disasters strike a country, there will be a statistically significant increase in economic growth of 1.08 percent for every one-unit change in the quality of government, to the five percent level. The quality of government variable remains insignificant, but with an interesting magnitude on the interaction term. With OLS, column (2) is stating that when a natural disaster occurs, it's effect based on the quality of government is a statistically significant decrease of 1.14 percent, to the ten percent level. This result contradicts my theoretical predictions, but provides more evidence for mixed results.

Columns (3) and (4) include fixed effects and controls for both time and country effects, and there is a noticeable difference throughout the columns. These columns show the negative relationship economic growth has with natural disasters and the positive relationship with quality of government. Columns (1) and (2) show a positive and significant value for disasters, but columns (3) and (4) reveal that there is a negative and statistically significant impact. These results state that with a one-unit change in the standard deviation of natural disasters there will be a statistically significant and negative 0.81 percent impact on economic growth to the five percent level. The quality of government variable returns a positive and statistically significant increase of 1.84 percent on economic growth to the ten percent level. Meaning that as the quality of government rises, economic growth should see an increase of 1.84 percent. The reasoning for this is that with the application of fixed effects there were some unaccounted-for errors that fixed

effects was able to capture, where OLS was unable to. OLS was overestimating the effects that natural disasters have on growth since it suffers from omitted variable bias, and fixed effects helps reduce that bias. Almost the same can be said about the quality of government variable, as the value increase slightly and becomes statistically significant, meaning it was underestimated.

Table 4 continues with equation (2) which shows the addition onto the fixed effects regression by including the interaction term of natural disasters and quality of government. This variable is included to see how both these variables work together. Overall, with the inclusion of the interaction term the impact of natural disasters sees an increase to the negative impact, and remains statistically significant. The coefficient on natural disasters increases from (-0.84) to (-1.82) percent. Column (4) shows that a one-unit change in standard deviation will lead to a statistically significant decrease of 1.82 percent of economic growth to the five percent level. The quality of government variable remains statistically significant to the ten percent level, but increases in magnitude from 1.84 to 2.11 percent change in economic growth as the quality of government increases. When looking at the interaction term, the result of the two variables shows a positive and statistically significant increase to economic growth of 2.10 percent. This means if natural disasters are held constant and there is an increase to the quality of government then there should be a positive impact, but as you will see with Fig.1, the quality of government must be very high to see this sort of impact.

Figure 1 includes graphical representation of the marginal effects of the fixed effects regression, with the sole purpose to demonstrate how the interaction term is behaving when interacted. When looking at Fig.1, as the quality of government is low, 0.1 – 0.6, there is a negative value for marginal effects on how the institutional quality impacts economic growth. The above dashed line shows the upward standard deviation which shows that there can be a

positive impact beginning at the 0.6 value for economic growth, but with a lot of variation the interaction effect is more probable when the two lines intersect. This graphically represents the interaction impact that these two variables have and shows that with a high-quality government there will be negligible impact on economic growth as the quality of government can negate the negative impacts of natural disasters. With the median quality of government being just around 0.54 there will most likely be a negative impact to the countries with low quality governments, but as the quality of government increases, it is shown that there is little to no effect of natural disasters with a high-quality government.

4.4 Econometric Issues

Like most empirical studies, there is always going to be a lack of data coverage when covering natural disasters and omitted variable bias. In my case, the lack of coverage comes from the quality of government variable. This is what restricts my data sample to a somewhat small sample size and leaves out some unanswered questions relating to the countries that lack coverage. Also, when using the original values for the growth calculation there is too much weight associated with original values making it tough to find proper results. Instead, I use the collapsed values for the growth calculation and included lagged variables to help control for the measurement error associated with the original values and to correct for the endogeneity bias. Even with the limitations of reducing my sample size which in return reduces my coverage, by including panel fixed effects, my results suffer from less omitted bias.

Random effects were considered, but later tested out by running a Hausman test which states that your regression is better off using random effects then fixed effects when you fail to reject the null hypothesis. Although they were tested out, running the Breusch-Pagan Lagrange Multiplier began the consideration as the results from this test suggests that random effects are

preferred over a simple OLS regression, but ultimately fixed effects are the best option. In my case, when comparing my fixed effects and random effects against one another with regressions with and without interaction, the reported Chi^2 values exceeded the test statistics and report a p-value of 0. After rejecting the null hypothesis that random effects are the preferred regression, I was in the clear to run my regressions with fixed effects. To test for the best fit, I ran the proper tests to clarify which regression has the best fit by determining the smallest, most negative, Akaike's and Schwarz's Bayesian information criteria, better known as AIC and BIC. As the regressions become more complex with the inclusion of interactions, time, and country effects the AIC and BIC become smaller and my best fit is Table 4 column (4). The use of time effects is justified by jointly testing to see if the dummies for all years are equal to 0. With a reported p-value of 0, I was able to reject the null hypothesis that has all years equal to 0 and conclude that time effects are needed in my regressions. Lastly, I decided to include Huber-White robust standard errors to help reduce the heteroskedasticity.

5. Concluding Remarks

In this paper, I present new evidence to support previous literature that natural disasters negatively impact economic growth. Employing the GAME and combining it with QoG dataset can provide future authors a dataset worth using. This paper shows that when natural disasters occur you are going to experience a 1.82 percent decrease in economic growth as natural disasters increase by one standard deviation. Also, it shows that when your quality of government increases there will be a positive and statistically significant impact on economic growth. Lastly, I have demonstrated that as the quality of a government increases, the negative impact that natural disasters have on economic growth are reduced.

Future researchers can expand on this field by using the GAME dataset to get high quality coverage of natural disaster specific characteristics to estimate the effects natural disasters have on growth. One recommendation would be to find a corruption index that has similar coverage to the GAME dataset to truly capture how institutional quality effects economic growth when interacted with natural disasters. Some policy recommendations would be to implement an updated vetting system into the electoral process to further examine the candidates and see if they are prone to any corruption. Updating the policies to deter corruption with improved checks and balances will ensure proper allocation of funds to aid the country's citizens.

Appendix A: Summary Statistics

Table 1: Description of Variables, Full Sample (N = 1,624)

Variables	Source	Description
Disaster Index	GeoMet	Sum of all types of disasters
Quality of Government	ICRG	Mean of corruption, law and order, and bureaucracy quality
Polity	Polity IV	Polity Index, normalized from 0 to 1
Growth Rate in Real GDP	PWT	Per capita GDP PPP growth
Log GDP	PWT	GDP per capita
Trade Openness	PWT	Imports + Exports (% of GDP)
Foreign Direct Investment	WDI	Net inflows of the external factor (% of GDP)
Domestic Credit	WDI	Domestic credit (% GDP)
Current Account Balance	WDI	Current account balance (% GDP)

Notes: Disaster index is the only variable that is not lagged

Table 2: Summary Statistics of Fixed Effects regressions using GAME and QoG datasets

VARIABLES	N	Mean	St. Dev	Min	Max
Growth rate of Real GDP	526	0.0409	0.0314	-0.175	0.232
Natural Disaster Index	526	0.0268	0.980	-2.933	2.973
Quality of Government $_{(t-5)}$	413	0.576	0.238	0.0556	1
Log GDP per capita $_{(t-5)}$	526	8.084	1.288	5.480	10.58
Trade Openness $_{(t-5)}$	526	0.676	0.444	0.126	3.785
Domestic Credit $_{(t-5)}$	526	0.565	0.443	-0.547	3.043
Current Account Balance $_{(t-5)}$	526	-0.0276	0.0630	-0.342	0.279
Polity $_{(t-5)}$	526	0.631	0.347	0	1
Foreign Direct Investment $_{(t-5)}$	526	0.0204	0.0297	-0.0417	0.230
*Natural Disasters * Quality of Government* $_{(t-5)}$	413	0.169	0.676	-1.423	2.828
Number of Countries	106	106	106	106	106

Notes: Disaster index is the only variable that is not lagged

Appendix B: Regression Tables

Table 3: Growth regressions with growth rate of GDP as dependent variable

VARIABLES	(1) OLS	(2) FE
Disaster Index	0.00485***	-0.00903***
	(0.00180)	(0.00316)
Control Variables		
Foreign Direct Investment $_{(t-5)}$	0.0612	-0.0588
	(0.117)	(0.0647)
Log GDP $_{(t-5)}$	-0.00274	-0.0698***
	(0.00208)	(0.00819)
Trade Openness $_{(t-5)}$	0.00846**	-0.00463
	(0.00386)	(0.00880)
Domestic Credit $_{(t-5)}$	-0.00365	0.00640
	(0.00311)	(0.00572)
Current Account Balance $_{(t-5)}$	-0.00811	-0.0656**
	(0.0321)	(0.0268)
Polity $_{(t-5)}$	0.00941*	-0.000508
	(0.00548)	(0.00486)
Constant	0.0483***	0.619***
	(0.0163)	(0.0703)
Observations	526	526
R-squared	0.222	0.514
Year Effects	Yes	Yes
Country Effects	No	Yes
Number of Countries		106

Notes: The dependent variable is change in growth rate of GDP per capita PPP. Each regression evolves over time to include time and country effects, which are not present in the regression table. Huber-White robust standard errors are used for fixed effects regressions. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4: Growth regressions with dependent variable growth rate of GDP

VARIABLES	(1) OLS	(2) OLS	(3) FE	(4) FE
Natural Disaster	0.00416**	0.0108**	-0.00814**	-0.0182**
	(0.00199)	(0.00469)	(0.00359)	(0.00777)
Quality of Government $_{(t-5)}$	0.0138	0.0152	0.0184*	0.0211*
	(0.00898)	(0.00941)	(0.0103)	(0.0109)
*Disasters * Quality of Government* $_{(t-5)}$		-0.0114*		0.0210*
		(0.00661)		(0.0113)
Control Variables				
Foreign Direct Investment $_{(t-5)}$	0.0931	0.108	0.0355	0.0327
	(0.129)	(0.122)	(0.120)	(0.113)
Log GDP PPP $_{(t-5)}$	-0.00296	-0.00282	-0.0804***	-0.0795***
	(0.00238)	(0.00239)	(0.0117)	(0.0115)
Trade Openness $_{(t-5)}$	0.00580	0.00384	-0.0183	-0.0187*
	(0.00443)	(0.00429)	(0.0114)	(0.0112)
Domestic Credit $_{(t-5)}$	-0.00697**	-0.00579*	0.00778	0.00786
	(0.00313)	(0.00301)	(0.00532)	(0.00531)
Current Account Balance $_{(t-5)}$	-0.00878	-0.00747	-0.105***	-0.115***
	(0.0412)	(0.0404)	(0.0327)	(0.0337)
Polity $_{(t-5)}$	-0.00157	-0.000735	-0.00584	-0.00907
	(0.00636)	(0.00632)	(0.00543)	(0.00588)
Constant	0.0538***	0.0390**	0.719***	0.710***
	(0.0162)	(0.0155)	(0.103)	(0.101)
Observations	413	413	413	413
R-squared	0.257	0.264	0.575	0.581
Year Effects	Yes	Yes	Yes	Yes
Country Effects	No	No	Yes	Yes
Number of Countries			96	96

Notes: The dependent variable is change in growth rate of GDP per capita PPP. Each regression evolves over time to include time and country effects, which are not present in the regression table. Huber-White robust standard errors are used for fixed effects regressions. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix C: Graph

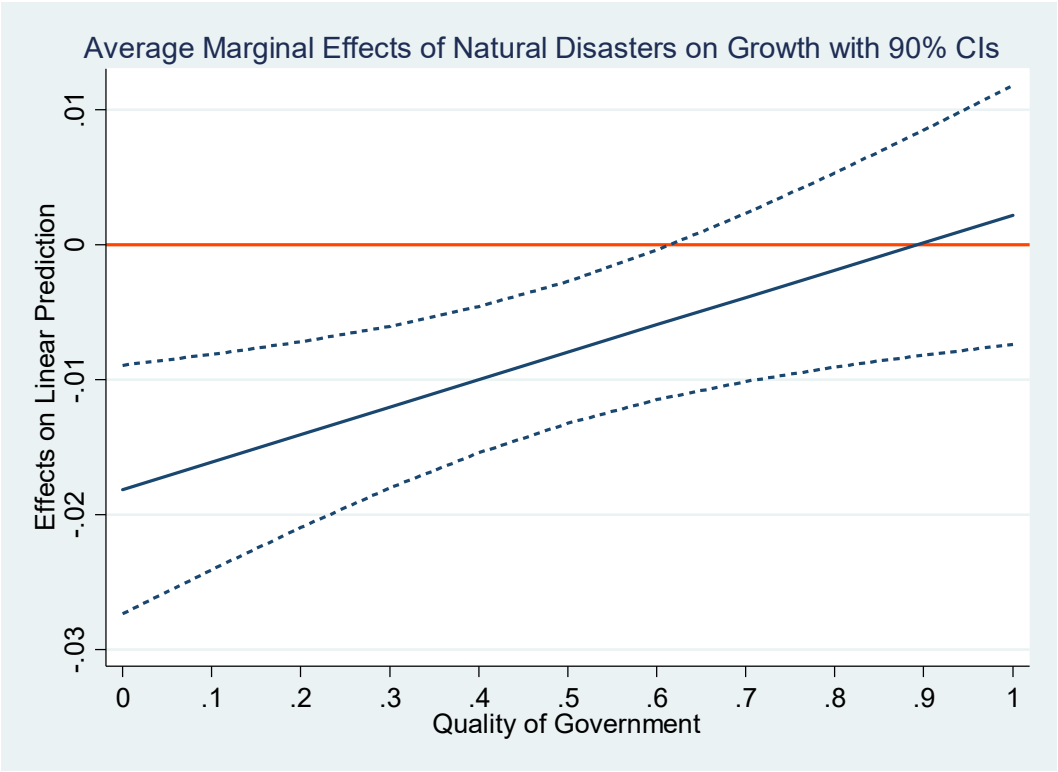

Fig. 1 – Marginal effects of the interaction of natural disasters and quality of government on economic growth

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