Damages of Natural Disasters

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Damage by Disaster: an empirical analysis of natural disasters

I. Abstract

Natural disasters create large amounts of financial damage, yet usually, the only damage reported over media. After analyzing much literature over the other externalities created by natural disasters, the primary descriptors of a country that were researched concerning the number of natural disasters in a country included gender equality, the level of corruption, and the financial damages created. Data was used from several databases that accounted worldwide for this information and then ran through python to test the correlations between the variables. After statistical tests were run, the only significant relationships found with natural disasters involved the monetary values of the damages and level of wealth in a country. Overall, natural disasters do create substantial effects worldwide and will only continue to worsen as climate change levels rise.

II. Introduction

I remember growing up watching the terror in the newscaster's eyes as they talked about the horrific results of Hurricane Katrina and the earthquake in Haiti. Living in south Texas has placed me on the front lines of hurricane alley; I've seen my family members and friends get trapped in their houses from floods and suffer economic damages on their cars and property.

I've always had an interest in big storms and meteorology; it's harder not to experience a natural disaster than it is to personally experience one nowadays, especially with climate change only making our disasters worse and more frequent. But what about the damages that we can not see? Living through a natural disaster takes a more significant effect on a person than just a flooded basement.

The fiscal damages left behind from natural disasters are often usually publicized in the media more so than any other outcome. These are often the statistics you see in news articles and on television. The death toll, the number of people injured and missing are usually the first couple of numbers popping up on a screen. Then it goes into the destruction of capital and infrastructure; how is this affecting the economy? How will this country or these people ever recover from it? Is the disaster bad enough to need humanitarian aid from outside the borders?

Lastly, an important stat, but one usually not seen until later on, did this event create a lasting crush on this country's exports or GDP?

This takes us deeper into the central points of this paper; what about the damages most people do not visually see? The damages caused by natural disasters that last for decades to come and are barely acknowledged, if at all. This paper goes into detail researching those damages and what the relationship is, if any, to unseen damages in a country and the frequency of natural disasters they experience.

The increased levels of climate change affect worldwide has led to an increase in frequency and severity of natural disasters that created the externalities of increased government corruption and gender inequality and decreased the overall wealth in a country.

III. Literature Review

When looking at the various damages caused by climate change and natural disasters, it affects the economies of those countries and the environment, behavior, and health of those who live in the communities affected, and the types of government in those countries.

Businesses

Natural disasters cause various types of damages, one of those being the most well-known as damaging different types of firms, especially businesses, even causing some to go bankrupt. Looking at the geography of an area during and after a natural disaster can be a significant determinant of whether or not those firms will end up going bankrupt. Firm bankruptcy is lower for more efficient firms both inside and outside the disaster-affected areas. (Hirofumi et al., 2014)

Luckily, not all firms will go bankrupt because of natural disasters, and they often incur different types of losses depending on the type and severity of the disaster. The increases in reported economic losses have been higher than the increases in disasters or numbers of people affected (Basher, 2008). Up to 1989, only in one year, 1980, were the losses over $30 billion, while after 1989 the losses every year exceeded this sum and in two years exceeded $150 billion, seeing that drastic increase in the number of fiscal damages (Basher, 2008).

We see various indirect and direct damages with natural disasters, often indirect effects creating more profound and longer-lasting problems for the affected areas. Natural disasters disrupt economic activities in the short term due to the direct and indirect damages they cause (Panwar & Sen, 2018). Direct damages occur in two forms, either a loss of labor or a loss of capital, with both usually occurring (Panwar & Sen, 2018). The government generally addresses direct losses when receiving and distributing aid for those affected, even though these losses are

much easier for communities to overcome the post-disaster event. However, direct losses may result in a further loss of potential labor hours and cause a decrease in the expected agricultural or industrial production (Panwar & Sen, 2018).

Indirect losses are associated with disasters that occur but cannot be directly attributed to the disaster's total physical impact. These include emergency costs, supply chain disruptions, falls in demand, consequences for economic growth, psychological trauma, social and community network disruptions, impacts on poverty, and impacts on security and stability (Noy & Dupont IV, 2018). The issues mentioned above can take decades longer to resolve after a disaster event because they can't be directly attributed, even though these consequences are usually the ones that those who fall victim to these natural disasters experience firsthand.

Additionally, indirect losses to households also include a loss of savings and household income and a loss of the time required to cope with the disaster's aftermath (Noy & Dupont IV, 2018).

Governments can see similar patterns in losses between businesses and private institutions following events of a natural disaster. As you can see in both of these graphs, the large spikes occur in both 2005 and 2017; both were years that featured massive hurricane, hurricane Katrina and hurricane Harvey respectively, (Board of Governors of the Federal Reserve System (U.S.), 2020) (U.S. Bureau of Economic Analysis, 2020). These graphs attempt to quantify the direct economic loss from 1982 to the end of 2020. However, it is still unable to quantify the correct amount of damages because of how hard it is to account for indirect losses.

When looking at economic losses as a whole, the variability with how long and how much money it takes for labor markets to get back to their pre-disaster level is greatly affected by the overall economy's diversity.

As seen in smaller businesses, there are adverse income effects for the self-employed 2–5 years after an earthquake, but positive effects 6–12 years afterward. One explanation for individuals' faster recovery could be the immediate and coordinated response to the disaster due to the type of government responding and the likeability of the geographical location (Kirchberger, 2017).

Prices of certain goods generally take significant hits after these events, especially anything greatly affected by weather, such as agriculture. There was a massive rise in the price of agricultural goods post-disaster because they took many economic hits (Kirchberger, 2017).

Also, there is variability in how different types of disasters can cause different amounts of economic loss. For example, Kirchberger's research over earthquakes has vastly different results from the reports over events such as flooding or tropical storms. Wage growth was not significantly different for workers who resided in earthquake-affected regions; private workers had somewhat higher wage growth, but the earthquake did not affect those self-employed, firm owners, or government workers (Kirchberger, 2017).

Although not as damaging as earthquakes can be, hurricanes and tropical storms have become exceedingly more common within the past 10 to 20 years due to climate change. These events have been much more damaging and costly, especially with higher category hurricanes such as Katrina or Harvey. It took New Orleans over ten years to get its labor force and employment back to pre-Katrina levels (Flowers, 2018). Events of this scale sent the city and much of the state into a deep economic depression. The economic recession of 2007-09 following the event did far more damage to the local GDP than the monetary damages caused by Hurricane Katrina (Flowers, 2018).

The insurance issue also creates a considerable problem with natural disasters. Having insurance isn't necessarily mandatory for them; this caused many indirect and direct losses from Hurricane Harvey and Katrina because so many of those homeowners did not have flood insurance.

Other disasters like earthquakes and wildfires in California, where insurance and building updates are more regulated, make it easier to file claims and receive compensation after those events.

California's insurance commissioner stated insurance claims arising from the California wildfires in October and December were nearly $12 billion. These included losses for homes and other types of dwellings but also cars, boats, and aircraft. Sonoma County had the most significant number of claims for direct losses—21,286—for a total loss of nearly $8 billion (Flowers, 2018).

The discrepancy between insured and uninsured losses was due to the flooding caused by Harvey, as well as the geographical location, Houston, the fourth-largest U.S. city, endured the brunt of the storm, Which led to an exceedingly high amount of infrastructure and firm damage because of the high population in the city. (Flowers, 2018)

Large-scale natural disasters, such as floods or earthquakes that cause widespread damage to many homes, were not typically covered by homeowners' policies. However, the insurance treatment of such disasters has changed over time (Drexler et al., 2019).

After private insurers mostly stopped offering protection against damage due to massive floods in the 1920s, the government found itself providing relief for flood victims on an ad hoc basis—paid for out of the general budget (Drexler et al., 2019). Those floods led to the development of the national flood insurance program and, later on, FEMA's (Federal Emergency

Management Agency) development as an independent agency to help people through government aid post-disaster in a more streamlined way. Unfortunately, the National Flood Insurance Program rarely forces property owners to consider the total costs of their decision to live in flood-prone areas. As a consequence of the NFIP, property owners continue to live in areas of frequent flooding (Yamamura, 2014). Besides failing to purchase insurance when living in those areas, of the estimated $25 to $37 billion in flood damage to Texas homes resulting from Harvey, about three-quarters was uninsured (Drexler et al., 2019).

One of the significant ways that countries have overcome and built better prevention of natural disasters is economic diversity. Economic diversity boosted employment growth and hastened income recovery post-disaster. The economic development strategy of increasing economic diversity helped enhance resilience after a disaster (Xiao & Drucker, 2013). One reason could be that having greater economic diversity allows for preventing a financial crash because the natural disaster that has just occurred obviously cannot destroy every market.

Economic diversity on its own substantially hindered income growth. Overall, financial variety slowed per capita income growth in normal circumstances, but after the disaster aided in weathering the short-term downturn and sped up the shift to a longer-term pattern of income gains (Xiao & Drucker, 2013).

An example we can see here is how it affects the housing prices in disaster areas; diversity dampens both the magnitude and the duration of the effects of a disaster on local real estate values (Coulson et al., 2020).

Although it is apparent with all the evidence that natural disasters create many disadvantages for communities and economies in the long term, there are ways to prevent it,

including our diversification of markets, better insurance regulations, and equal distribution of federal aid.

Government

Natural disasters cause more issues in countries with certain types of governments. For example, the level of corruption or freedom in a government can correlate with how the country prepares and responds to natural disasters. The number of disasters that strike a country can lead to more significant values of corruption.

The damage caused by natural disasters has found that low-quality governance, characterized by corruption and income inequality, increases death rates (Yamamura, 2014). Corruption within a government can have many underlying effects; the possible relationship between this and the increased deaths from natural disasters could be the government's failure to take the problem seriously and focus more on its people and provide aid.

One article states that the larger than the average number of disasters in non-OECD countries than in OECD countries possibly reflects that developing countries exaggerate the number of disasters to receive international aid (Yamamura, 2014). I don't particularly agree with this statement because developing countries are not exaggerating since they receive very little assistance in general. They don't have as much money as developed nations to prevent and manage disasters, unlike developed countries like the U.S. who have FEMA established.

Closed undemocratic societies may also underreport natural disasters. For example, China reported an average of less than one disaster per year over the period 1960-1979 (Strömberg, 2007). In addition, certain authoritarian governments only want to spend aid on the country's affected regions and often under-report so that they will not look bad in the media.

A country's corruption level tends to reflect the average damage of each disaster, not frequency; earthquakes (rare) and tropical storms (common) cause the most increases in corruption (Yamamura, 2014).

More democratic countries experience fewer human losses than less democratic countries, and more decentralization has fewer disaster deaths (Skidmore & Toya, 2013). These more democratic countries allow the people to speak better for themselves, and their outcries receive much more attention than those in authoritarian governments. More democracy and more decentralization enable these countries to better prepare and prevent these natural disasters and do a better job of listening to the people regarding where and how to provide aid. Countries that moved towards decentralization experienced a reduction in fatalities four times greater than a country with a high decentralization level (Skidmore & Toya, 2013).

Some of these countries have specific areas that disapprove of the government, such as China. Politically weak or hostile regions in these types of countries have low levels of wealth, and hence, the government will not spend much on these regions. Therefore, this observation that disasters will "tend to happen" in opposition-aligned areas is wildly inaccurate. Furthermore, these disasters are more broadcast because the low-income areas take worse hits to their already poorly-built infrastructure (Cohen & Werker, 2008). Then there's the fact that, as mentioned above, they could entirely go without reporting this event to the public or drastically underreport the severity of it. These effects imply that a sufficiently callous and inadequate government may choose to invest meager amounts in disaster prevention, especially in politically hostile areas (Cohen & Werker, 2008).

Another very detrimental factor to the number of deaths and how long it takes for a particular country to get the economy back to pre-disaster levels is the idea of it being a

developed or developing nation and its GDP and other factors. An increase in income leads to improvements in general safety and additional protection against natural disasters (Skidmore & Toya, 2013).

High-income countries face a lower mortality risk from natural hazards since they can better afford measures to limit the effects of natural disasters. Technology such as buildings made of better and more durable materials, houses that have raised platforms to withstand floods, agricultural irrigation to reduce losses during droughts, and warning systems for certain natural disasters, can save lives. After a disaster strikes, measures such as bringing in medical care and food and mass evacuations can limit the negative consequences of the disaster (Strömberg, 2007). Unfortunately, all of these infrastructure methods to better help these countries with natural disasters cost a lot of money. These developing or more impoverished nations either have low levels of wealth or corrupt governments that spend the wealth in places unrelated to natural disasters.

The disparity between wealthy and developing nations with natural disasters is very prevalent in death count, even more so than economic damage. The number of disasters, population, and number exposed are about equal in low vs. high-income countries, but the death count in low income is 907,000 and 75,000 in high income. Concerning the population, the death rate is the highest in Africa (Strömberg, 2007). More affluent countries will be less tempted by the potential for aid racketeering. It is quite a strict policy to allow the suffering of one's population to get an income and foreign exchange. Only the most desperate of governments with the highest marginal utilities of income would be willing to go to such lengths. Those governments are the ones with virtually no other source of income (Cohen & Werker, 2008).

Federal disaster relief in countries varies. The concept of countries helping other countries worldwide is seen with the Red Cross in the United States and United Nations globally.

When the United States president issues a presidential disaster declaration, FEMA can step in to provide direct assistance to homeowners and others through the Disaster Relief Fund. Also, the Small Business Administration (SBA) can offer subsidized disaster loans to households and businesses. For example, FEMA got 7.3 billion U.S. dollars in 2017 for Hurricane Harvey (Drexler et al., 2019).

Countries that lie far away from the major donors are systematically disfavored when it comes to disaster relief (Strömberg, 2007). However, in the U.S. specifically, there is no general correlation between this, and in fact, we tend to see the opposite.

Overall, the population is becoming more comfortable that government aid is available when disasters strike, so we have more people moving to those areas. As a result, the out-migration response to disasters increased after 1980. Counties that faced storms or hurricanes received more FEMA transfers in a given decade, but there is no association between a severe disaster event and the extent of FEMA funding (Boustan et al., 2020).

People

Those who do not die from natural disasters still deal with horrible trauma, grief, and disadvantages, which are significantly worse when looking at underrepresented or discriminated groups of people such as African Americans, lower class, and pregnant women.

In particular, children born to black mothers who experienced adverse effects from hurricane exposure were two times worse than averages of all children. In addition, they had much worse overall test scores, and these children were much more likely to need special education in schools throughout their lives (Fuller, 2014).

On the other side of things, we can see how variation in ethnicity and race can be terrible for areas that suffer from natural disasters. For example, countries with high ethnic fractionalization have almost three times more deaths and people affected (Cohen & Werker, 2008).

We see substantial disparities when it comes to male vs. female survival with natural disasters. The most remarkable was the higher death rate for females than for males across most age groups. In the age groups between 30-54 years, females' death rates were as much as two to three times higher than those for men (Basher, 2008).

The explanation is easier to understand in countries where women have fewer rights than men as they must abide by more rules, such as staying in the house and caring for the children where the men are out doing the so-called 'rougher work' out in the field. The disaster affects societies in which the socioeconomic status of women is low. In these communities, natural disasters will kill directly and indirectly via related post-disaster events, kill more women than men, and kill women younger than men (Neumayer & Plümper, 2007).

As we saw in the section above, there is a massive disparity with deaths and damages between rich and developing countries. Moreover, it is very prevalent within these countries among the upper and lower classes. Larger college-educated population shares generally helped increase employment growth after natural disasters (Xiao & Drucker, 2013).

A severe disaster event leads to lower family income, heightened out-migration rates, and lower housing prices in a county over the decade. Out-migration after a natural disaster may be selective by income level. If affluent households have more resources to leave an area struck by catastrophe, out-migration may lead to a higher poverty rate among residents who stay in those areas. The poor may also be more willing to trade off a lower housing price for a heightened risk

of disaster activity. Alternatively, natural disasters may have a causal effect on the probability of falling into poverty for the existing population if, for example, some residents lose their jobs due to falling labor demand in the area (Boustan et al., 2020).

The behavior within communities pre, post, and during these disasters is fascinating and changes a lot depending on the affected area's socioeconomic characteristics. For example, communal participation and cooperation tend to increase during a calamity, in turn diminishing the number of conflicts in the affected community considerably, creating this immediate refocusing on the social function of mutual support (Lemieux, 2014). Furthermore, supplying financial aid to disaster victims could also have a preventive effect on the crime rate. In fact, on the days of relief check distribution, the number of reported crimes against property was much fewer than the expected tendency, with an overall decrease of 12% (Lemieux, 2014).

Interestingly enough, these findings contrast a lot with the typical behavior of a singular person after a traumatic event; it has a lot to do with the social support of the community post-disaster. Losses to social capital, damaging as they are to everyday quality of life, can hinder disaster recovery at the community and the individual level. At the personal level, recovery entails overcoming psychological and emotional responses, including anxiety, depression, and grief. Social support networks play a crucial role in overcoming these disaster effects (Gaddis et al., 2007).

The population that receives the worst effects from natural disasters is children and infants who can barely understand these events' cause and effect and often are overlooked when addressing where financial and mental health aid should go.

Children or family members can be injured or killed, or they can contract illnesses from post-disaster conditions. In addition, families may lose income either because employed

household members lose their jobs due to injury or macroeconomic conditions or because working household members die. In many developing-country contexts, loss of revenue, combined with the loss of assets and higher expenditures for disaster repairs, could cause a household to send children into labor for money that the family desperately needs (Kousky, 2016).

After Hurricane Katrina struck the U.S. Gulf Coast in 2005, a survey of those living in housing subsidized by FEMA found that access to medical care was fragmented or nonexistent. For example, many children of surveyed families were unable to get asthma medications, and half of the children who had a personal doctor before the storm didn't have one afterward (Kousky, 2016). Not only that, but these impoverished families will not be able to afford much of anything when it comes to the United States healthcare system with getting mental or physical treatment. Also, for families living in FEMA-subsidized housing after Katrina, half of the parents reported that at least one of their children had emotional or behavioral difficulties that hadn't been there before hurricane Katrina (Kousky, 2016).

As a result of Katrina, New Orleans had to triage care for more than twenty infants in its neonatal intensive care unit without adequate power, supplies, or communication with the outside world (Kousky, 2016). Children's health may be more vulnerable to a disaster for several biophysical reasons. For example, their respiratory rates are higher, their immune systems are less mature, and many of their organs are still undergoing rapid growth and development. In addition, fetuses in the womb and very young children are particularly susceptible to worse or longer-term impacts from adverse health shocks.

A careful study of births in Texas from 1996 to 2008 found somewhat different effects among women who experienced hurricanes. Living closer to areas with many tropical storms

increased the probability of labor or delivery complications by 30%. In addition, the likelihood of abnormal conditions, such as the baby requiring a ventilator for more than thirty minutes, increased by 60% (Kousky, 2016). The damages of hurricanes affect infants and children of all ages; hurricane exposure among the younger children creates significant changes in test scores and special education placement that suggests substantial selection into having a baby following a hurricane. Math scores also decreased significantly, by 1.7% of a standard deviation (Fuller, 2014).

Sadly it is not just hurricanes causing these horrible outcomes on children and congenital disabilities on infants. Maternal stress resulting from an earthquake in California was associated with lower gestation times and more birth defects. Infants and pregnant mothers who give birth after natural disasters have extreme effects throughout their lives, such as learning complications. Studies show scores in math and reading decrease between 1% and 5% of a standard deviation. The probability of special education placement increases between 10% and 20% among infants who grow up after experiencing natural disasters (Fuller 2014).

Environment

The most noticeable effect that natural disasters have on the environment itself is a result of climate change. This phenomenon is making disasters not only more severe but also more frequent. In recent years, a significant rise in the frequency and intensity of natural disasters has resulted in the heartbreaking loss of human lives and physical capital destruction. Moreover, the loss and damages caused by natural disasters will rise further in the future, mainly due to climate change (Panwar & Sen, 2018).

The issue of climate change is bringing a new dimension to the field of disaster risk reduction. Among the most immediate concerns associated with climate change is the expected

increase in extreme weather and climatic conditions, signs of which are already evident (Basher, 2008).

The issue with communicating these problems and their relation to climate change are that the instantaneous thought of the words' climate change' presents the idea of the Earth getting hotter or air pollution, which technology can mitigate to some extent. Yet, there is only so much that we can do to prepare for natural disasters because there is no way that we can prevent them from ever happening. Funny enough, I think the lousy movie Geostorm is not necessarily a work of science fiction. Instead, it is only a couple of decades of its time about how terrifying natural disasters will be and how humans have just not fully realized yet we can't stop them from happening.

Although the total number of disasters reported worldwide has been rapidly increasing, the number of killed has not (Strömberg, 2007). Climate change is causing more disasters at a higher severity; our technology has just adapted enough to medically treat those affected and go for rescue missions to save those who would otherwise die.

IV. Description of the Topic

My topic features the relationship between natural disasters and several socioeconomic variables in different countries. When conducting research, the types of disasters researched were floods, droughts, storms, earthquakes, landslides, wildfires, heatwaves, and volcanic eruptions. This project left epidemics, and biological disasters out since the harm those events caused were due to a living organism. Also, I was not interested in COVID-19 creating a significant skew in my data.

When I started my project, I had a slew of research questions about the economic influence natural disasters created and any long-lasting results that were often overlooked. So I narrowed my investigation down to four main questions:

- What are the monetary damages created by disasters?
- Is one type of disaster economically worse than another?
- Do natural disasters cause gender equality or government corruption in a country?
- Is there a correlation between the frequency of disasters, the intensity, and factors involving climate change?

When it comes to damages, several extraneous variables could be considered when trying to create a broad understanding of the actual impacts of natural disasters. Therefore, I decided to choose variables from different categories, government corruption for political, financial damages for economic, gender equality for social, and climate change relationships for environmental.

The first is government disturbances; I started looking into the information regarding this topic after finding many related articles while conducting my literature review. I focused on the relationship between the frequency of natural disasters and the level of democracy and corruption in a country's government.

Financial damages and the level of wealth in a country were also one of the primary factors observed. Countries with lower GDP and developed infrastructure are typically the ones highlighted in the media most often after a hurricane or earthquake, but are they hit most often by disasters?

Next is gender inequality; it's already challenging to rank a country on how it compares to others with quantitative values, much fewer ones that require data from various sources such as levels of education among women, employment of women in the country, and so on. Finally, children who have witnessed or experienced a natural disaster at a young age or before being born have a much higher risk of developing learning disabilities; a couple of articles I found spoke on this, but it was somewhat difficult to find my own data.

Lastly, climate change was necessary to include; the only issue: there is no finite way to quantify climate change in a country. Therefore, the overall levels of disasters were observed instead of looking at it country-by-country basis, such as the other three variables mentioned.

V. Materials and Methods

The research was conducted using data collected from various research papers referenced in the works cited and multiple databases with downloadable spreadsheets of the desired data.

EM-DAT.be or the International Disasters database is a non-profit organization that is based out of Belgium. Their website featured an extensive data set on every natural disaster recorded in the past twenty years. This set includes the type of disaster, location, deaths and injuries, economic losses, and CPI. The dataset was extensive and featured almost 8,000 recorded disasters of all types observed in this research.

The following database included is Transparency International, a global, non-profit organization that works to end government corruption. This database included a spreadsheet of countries and their calculated corruption perceptions index from the last ten years. This set included 183 countries and was used when researching government corruption in a country concerning the natural disaster frequency.

For researching the wealth in a country, the databases used were WID (World Inequality Database) and Credit Suisse's Global Wealth Report from 2020. In addition, climate change was observed using data from the World Bank. Finally, gender equality was researched using OECD (Organization for Economic and Co-operation and Development) using data exploring the number of women who achieve higher education and the level of the wage gap by gender in different countries.

Several papers were observed when first searching for data and advice on how the study should be conducted. The first paper, *The effect of natural disasters on economic activity in U.S. counties: A century of data*, dives deeper into the financial damages. What do these disasters do to our firms, infrastructure, GDP, wages? Can we move on from it and fix the problem? Next is T*he Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy*. Personally, this was the most exciting paper I found while researching. The authors illustrate their found correlation between countries that experience more disasters and the level of gender equality there. This paper sparked my interest in that question and led me to uncover that women are killed and injured much worse and more frequently than men by these events while reading other papers. Then we have a paper speaking on the long-term effects created by climate change, *The Long-Term Consequences of Disasters: What Do We Know, and What We Still Don't*.

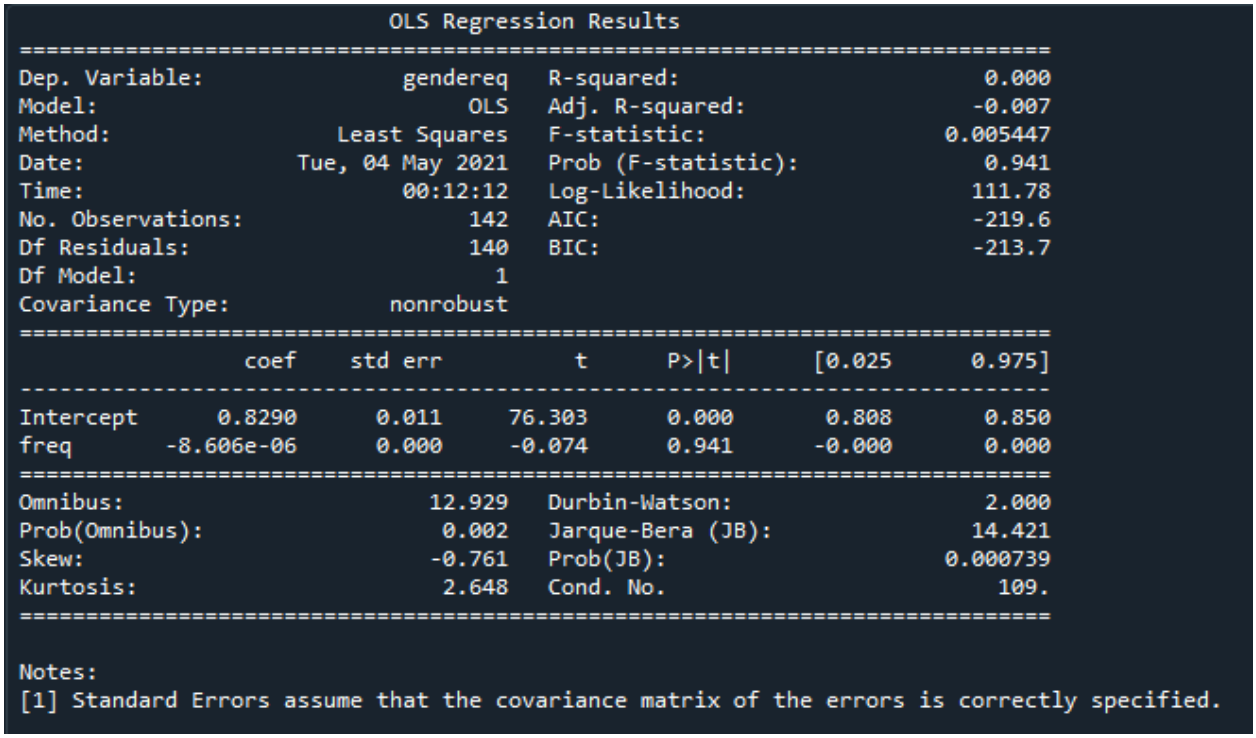
The next featured paper is *The impact of natural disaster on public sector corruption*; it touches on the other parts of my research questions, the first being the possible relationship of natural disasters and public corruption. Do these events make countries more corrupt? Why? The following paper jumps off of that and goes along with the gender one, The *Impact of a Natural Disasters on Altruistic Behaviour and Crime*, looking at social justice views. The ability to

empathize during a natural disaster can lead people to care about others more often. Lastly, the main featured paper, *Economic Impact of Natural Disasters: An Empirical Re-examination*, included a look at the primary data of damages and frequencies of disaster types.

The data was compiled through the databases mentioned above usage, many of them allowing their collected data to be downloaded into an excel file with a simple click. This allowed for a more straightforward analysis of data.

The data was taken from the different spreadsheets and compiled into one massive spreadsheet featuring all of the following variables: average corruption perceptions index (CPI) from the past ten years (avgcpi), the total wealth of a country in billions USD (wealth), gender equality calculated from average human development index and average gender development index (gendereq), the total number of natural disasters that hit a country in the past twenty years (freq), total damages from disaster $USD (totdmg), total deaths from all disasters occurred (totdead), the total number of people affected (totaff).

Each of the dependent variables was tested in a linear regression test against the freq variable to calculate how the number of disasters accounted for affected each of these factors looked at in the studies.

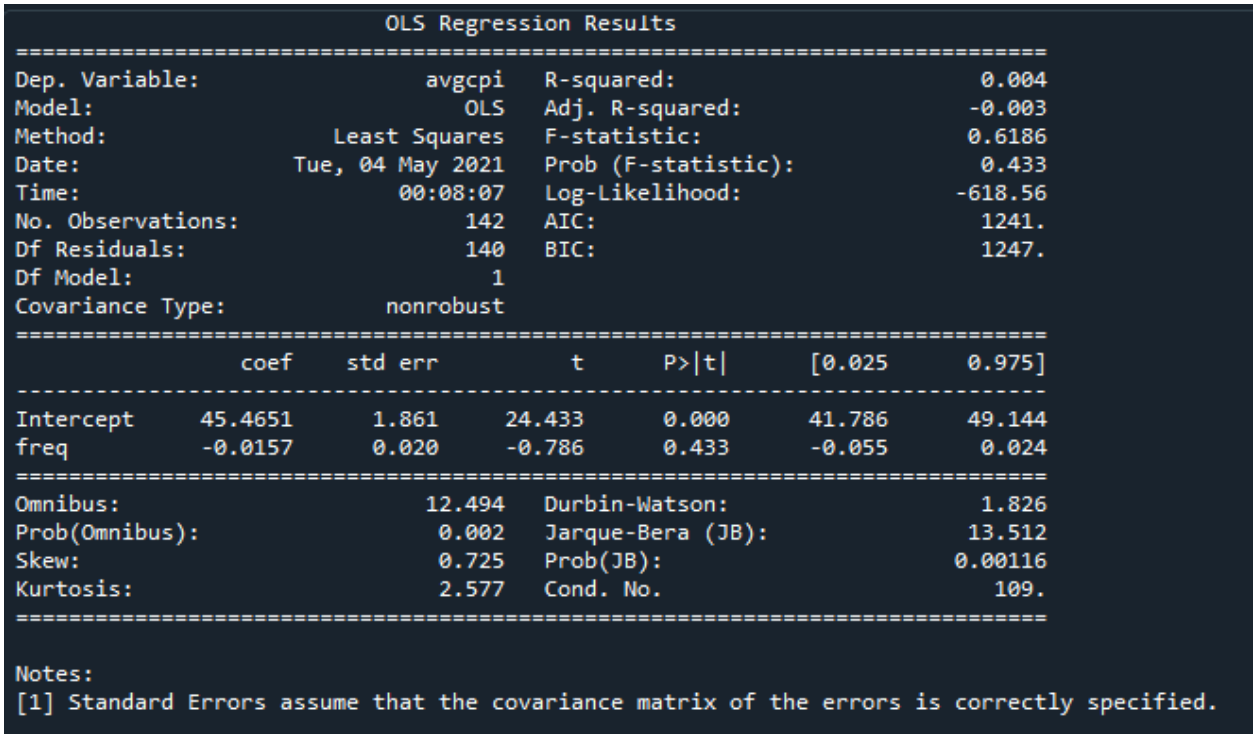


```
                            OLS Regression Results
==============================================================================
Dep. Variable:              gendereq   R-squared:                       0.000
Model:                          OLS   Adj. R-squared:                 -0.007
Method:               Least Squares   F-statistic:                  0.005447
Date:              Tue, 04 May 2021   Prob (F-statistic):              0.941
Time:                      00:12:12   Log-Likelihood:                111.78
No. Observations:               142   AIC:                           -219.6
Df Residuals:                   140   BIC:                           -213.7
Df Model:                         1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.8290      0.011     76.303      0.000       0.808       0.850
freq       -8.606e-06      0.000     -0.074      0.941      -0.000       0.000
==============================================================================
Omnibus:                       12.929   Durbin-Watson:                   2.000
Prob(Omnibus):                  0.002   Jarque-Bera (JB):               14.421
Skew:                          -0.761   Prob(JB):                     0.000739
Kurtosis:                       2.648   Cond. No.                         109.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 1.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with gender equality. The p-value is 0.941, which is greater than 0.05, which is not significant.



OLS Regression Results

Dep. Variable:	avgcpi	R-squared:	0.004
Model:	OLS	Adj. R-squared:	-0.003
Method:	Least Squares	F-statistic:	0.6186
Date:	Tue, 04 May 2021	Prob (F-statistic):	0.433
Time:	00:08:07	Log-Likelihood:	-618.56
No. Observations:	142	AIC:	1241.
Df Residuals:	140	BIC:	1247.
Df Model:	1		
Covariance Type:	nonrobust		

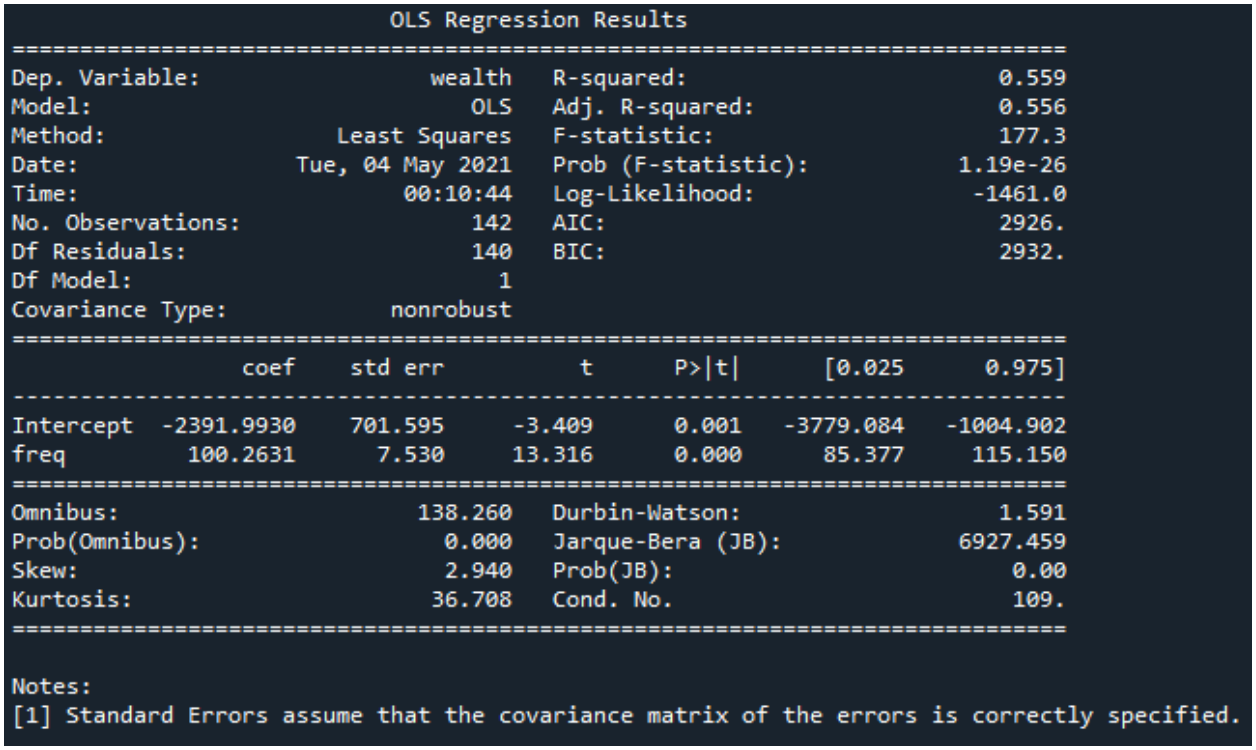
	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	45.4651	1.861	24.433	0.000	41.786	49.144
freq	-0.0157	0.020	-0.786	0.433	-0.055	0.024

Omnibus:	12.494	Durbin-Watson:	1.826
Prob(Omnibus):	0.002	Jarque-Bera (JB):	13.512
Skew:	0.725	Prob(JB):	0.00116
Kurtosis:	2.577	Cond. No.	109.

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 2.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with level of corruption. The p-value is 0.433, which is greater than 0.05 which is not significant.

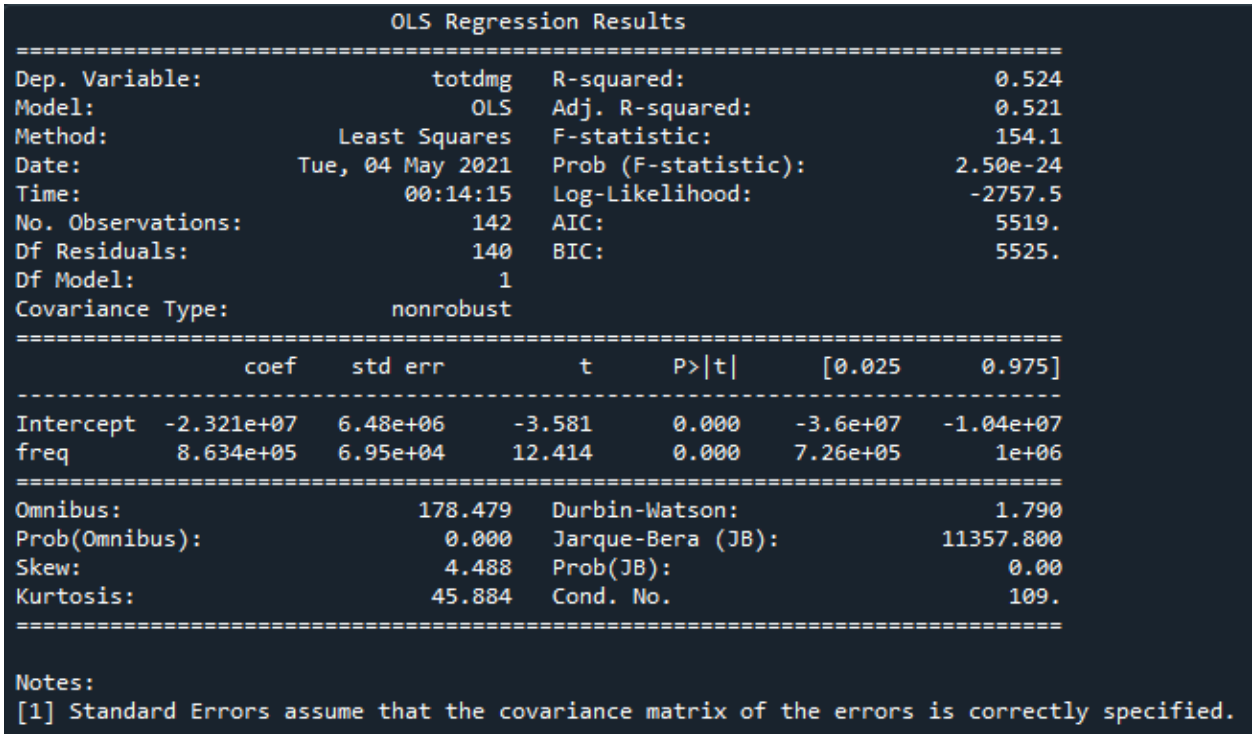


```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 wealth   R-squared:                       0.559
Model:                            OLS   Adj. R-squared:                  0.556
Method:                 Least Squares   F-statistic:                     177.3
Date:                Tue, 04 May 2021   Prob (F-statistic):           1.19e-26
Time:                        00:10:44   Log-Likelihood:                -1461.0
No. Observations:                 142   AIC:                             2926.
Df Residuals:                     140   BIC:                             2932.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept  -2391.9930    701.595     -3.409      0.001   -3779.084   -1004.902
freq         100.2631      7.530     13.316      0.000      85.377     115.150
==============================================================================
Omnibus:                      138.260   Durbin-Watson:                   1.591
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             6927.459
Skew:                           2.940   Prob(JB):                         0.00
Kurtosis:                      36.708   Cond. No.                         109.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 3.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with wealth in a country in billions USD. The p-value is less than 0.05, which is significant.

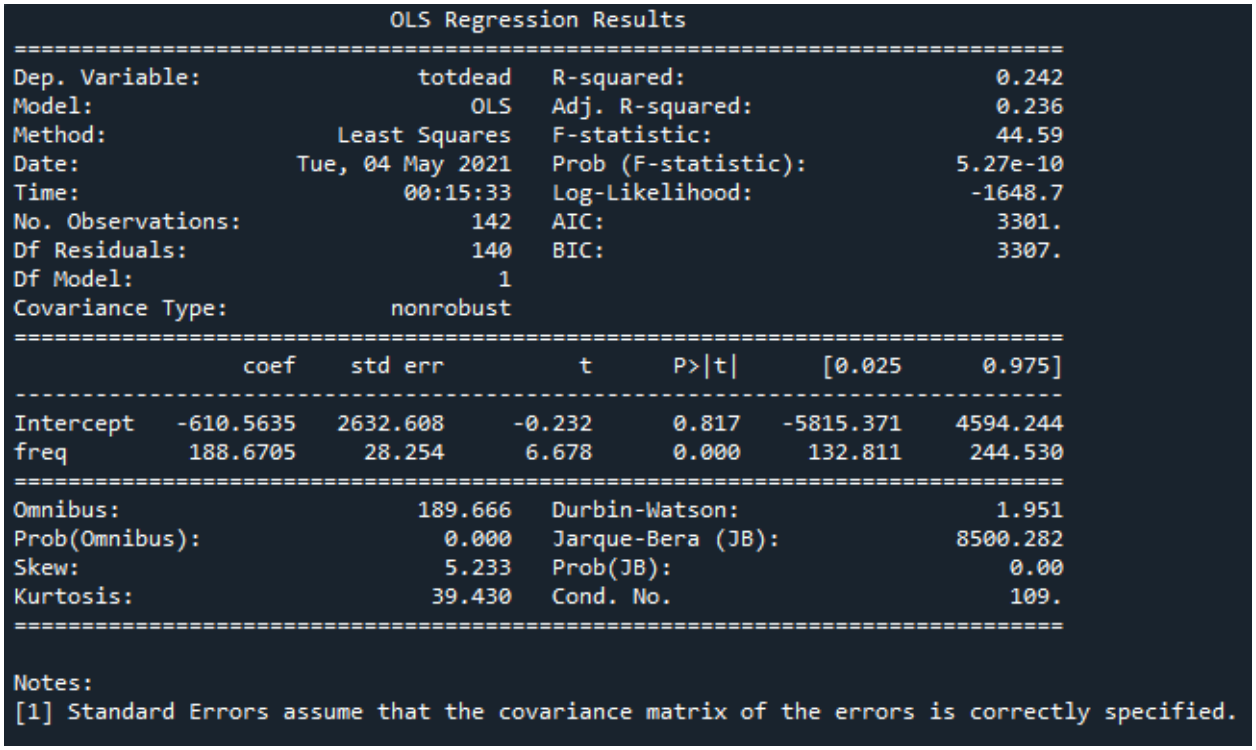


```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 totdmg   R-squared:                       0.524
Model:                            OLS   Adj. R-squared:                  0.521
Method:                 Least Squares   F-statistic:                     154.1
Date:                Tue, 04 May 2021   Prob (F-statistic):           2.50e-24
Time:                        00:14:15   Log-Likelihood:                -2757.5
No. Observations:                 142   AIC:                             5519.
Df Residuals:                     140   BIC:                             5525.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept  -2.321e+07   6.48e+06     -3.581      0.000    -3.6e+07   -1.04e+07
freq        8.634e+05   6.95e+04     12.414      0.000    7.26e+05       1e+06
==============================================================================
Omnibus:                      178.479   Durbin-Watson:                   1.790
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            11357.800
Skew:                           4.488   Prob(JB):                         0.00
Kurtosis:                      45.884   Cond. No.                         109.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 4.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with total amount of damages from disasters in USD. The p-value is less than 0.05, which is significant.

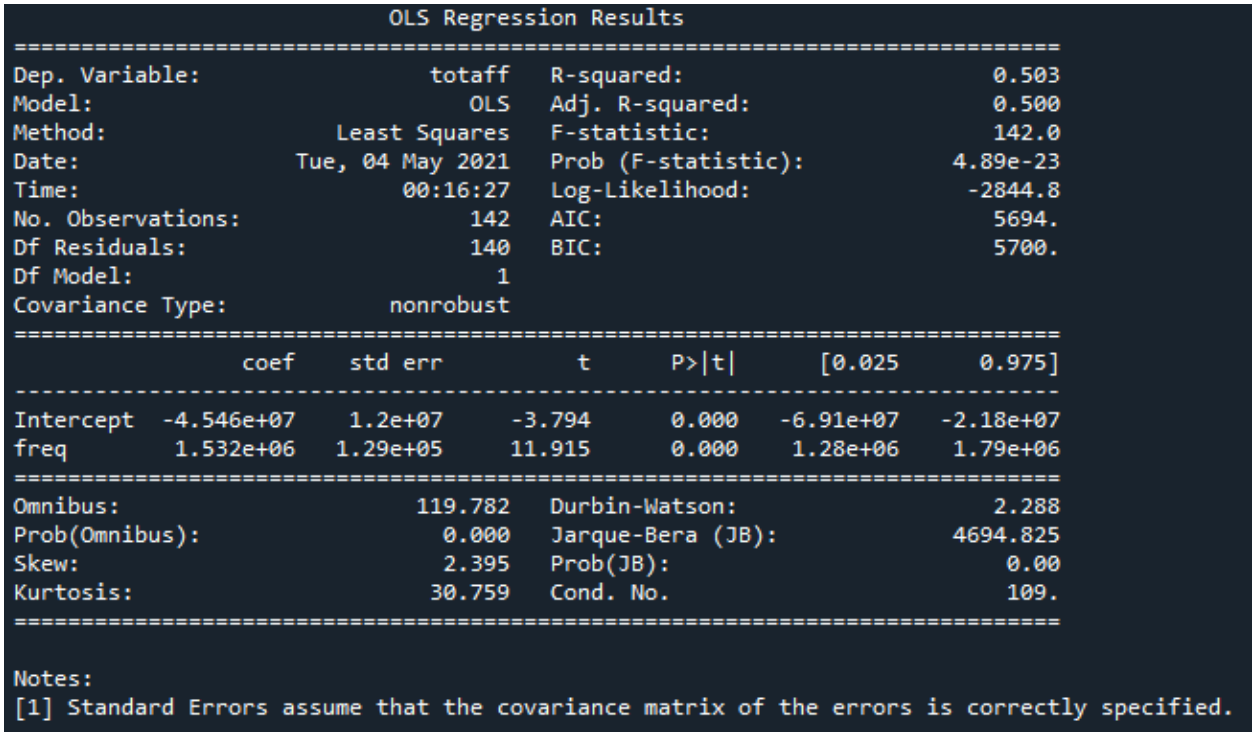


```
                            OLS Regression Results
==============================================================================
Dep. Variable:                totdead   R-squared:                       0.242
Model:                            OLS   Adj. R-squared:                  0.236
Method:                 Least Squares   F-statistic:                     44.59
Date:                Tue, 04 May 2021   Prob (F-statistic):           5.27e-10
Time:                        00:15:33   Log-Likelihood:                -1648.7
No. Observations:                 142   AIC:                             3301.
Df Residuals:                     140   BIC:                             3307.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept   -610.5635   2632.608     -0.232      0.817   -5815.371    4594.244
freq         188.6705     28.254      6.678      0.000     132.811     244.530
==============================================================================
Omnibus:                      189.666   Durbin-Watson:                   1.951
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8500.282
Skew:                           5.233   Prob(JB):                         0.00
Kurtosis:                      39.430   Cond. No.                         109.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 5.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with total deaths from disasters. The p-value is less than 0.05, which is significant.



```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 totaff   R-squared:                       0.503
Model:                            OLS   Adj. R-squared:                  0.500
Method:                 Least Squares   F-statistic:                     142.0
Date:                Tue, 04 May 2021   Prob (F-statistic):           4.89e-23
Time:                        00:16:27   Log-Likelihood:                -2844.8
No. Observations:                 142   AIC:                             5694.
Df Residuals:                     140   BIC:                             5700.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept  -4.546e+07    1.2e+07     -3.794      0.000   -6.91e+07   -2.18e+07
freq        1.532e+06   1.29e+05     11.915      0.000    1.28e+06    1.79e+06
==============================================================================
Omnibus:                      119.782   Durbin-Watson:                   2.288
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4694.825
Skew:                           2.395   Prob(JB):                         0.00
Kurtosis:                      30.759   Cond. No.                         109.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 6.

This features the output of the Ordinary Least Squares test when run through python comparing frequency with total persons affected by disasters. The p-value is less than 0.05, which is significant.

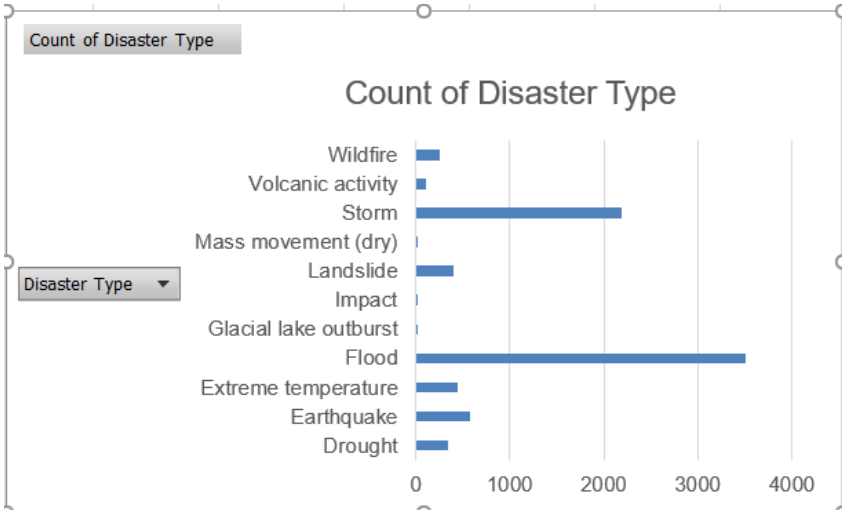


Figure 7. A graph calculating the frequency of natural disasters recorded by type.

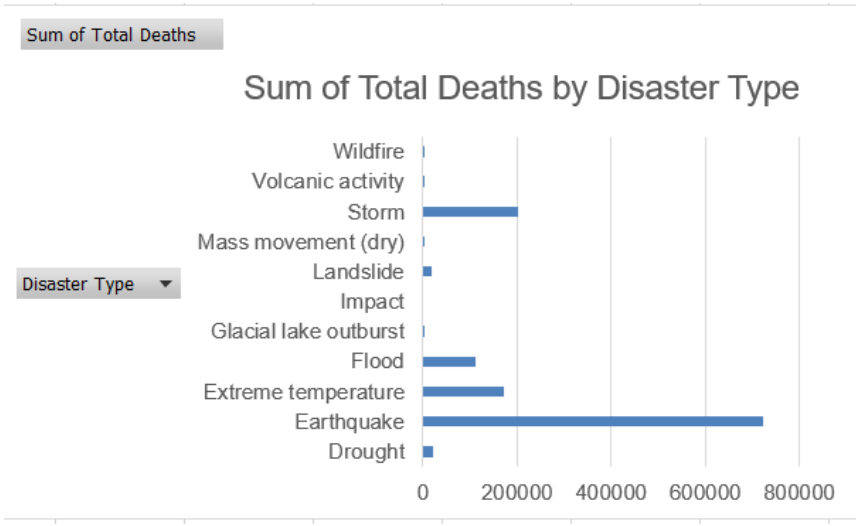


Figure 8. A graph calculating the number of deaths recorded by type of natural disaster.

```
import pandas as pd
import numpy as np
import statsmodels.formula.api as smf

PATH = pd.read_csv(r'seniorprojdata.csv')

df = pd.DataFrame(PATH, columns = ['avgcpi','wealth','gendereq','freq', 'totdmg','totdead','totaff'])
reg_results = smf.ols(formula= 'totaff ~ freq' , data=df).fit()
print(reg_results.summary())
```

Figure 9. A screenshot of the code used in python when conducted the analysis.

VI. Results

The results of the statistical analysis displayed that the tests that were significant included: wealth, damages, dead, affected. When tested against the number of disasters recorded in a country, all of these variables had a p-value lower than 0.05. This means that there is a significant relationship. An increased number of natural disasters in a country leads to lower levels of wealth in a country, higher values of damage recorded, and higher numbers of deceased and people affected.

The tests run on the number of disasters recorded in a country against CPI and level of gender equality were not significant (p-value greater than 0.05), concluding that there is no significant relationship.

VII. Discussion

Contrasting with many of the papers I referenced, I did not find any relationship between disaster frequency and level of corruption as found in Yamamura's article. I also did not find any relationship with gender equality, as seen in Neumayer & Plümper's article. The main correlations I found after my research involved the financial aspect of my research. When it comes to disaster on a type-analysis, floods created the most fiscal damages, and earthquakes led

to the most deaths. Results show that climate change has increased the overall amount of natural disasters by an average of 4.5% per year, as analyzed from my data. Unfortunately, finding the level of climate change in a country was not necessarily possible and remained the only variable of data I could not find a database for.

The reason for my results not entirely aligning with my original hypothesis and other papers researched could be the issues of countries studied, creating a bias since my pool of data was extensively larger than any other papers researching the topic.

VIII. Conclusion

The original hypothesis of this research was that countries with higher numbers of natural disasters experience higher rates of government corruption and gender inequality, lower rates of wealth and that climate change levels have increased the number of disasters worldwide. Overall, there is some correlation between natural disasters and the variables I decided to study, but more so the quantitative ones (financial damages and deaths) rather than the qualitative ones (gender equality and corruption). Overall, climate change, as hard as it is to quantify, was primarily left out of a good portion of my research after it was deemed impossible to calculate on a country-by-country basis as most of my research was conducted.

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