Is the U.S. really experiencing more major natural disasters?

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ABSTRACT

Official U.S. government statistics show since 1980 a growing number of natural disasters that result in economic damages of more than one billion dollars. However, a key reason for this increase is that the economy is bigger today than in previous decades. When the economy was smaller, disasters caused less economic damage. Accounting for growth in the US economy using changes in fixed assets and consumer durables shows the U.S. gains an additional billion-dollar natural disaster about every 16 years, not every 4 years as the unadjusted data suggest.

HIGHLIGHTS

- The U.S. government's National Oceanic and Atmospheric Administration tracks the number of billion dollar disasters going back to 1980.
- NOAA's data show a gain of one additional billion-dollar natural disaster on average every four years.
- When the economy was smaller, disasters caused less economic damage.
- NOAA does not adjust the data for economic growth, only inflation.
- Accounting for growth using the Bureau of Economic Analysis' data on fixed assets and consumer durables shows one additional billion-dollar disaster about every 16 years.

JEL classification: Q54, Q51, C8, R1

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1. Introduction

In 2017 the U.S. experienced two major hurricanes back-to-back; Harvey and Irma. Harvey, which inundated Houston, Texas and Irma, which inundated Florida, caused billions in economic damage. During the reporting of these disasters commentators suggested rising sea levels and sea temperatures will result in stronger storms causing increasing amounts of damage (Friedman, 2017). However, even if hurricanes strike with the same ferocity as in the past, economic growth and development will result in storms causing more damage, simply because there is physically more to destroy.[1]

The number of major natural disasters occurring in the U.S. is tracked by the government's National Oceanic and Atmospheric Administration (NOAA). NOAA maintains the "Billion-Dollar Weather and Climate Disasters" site online at https://www.ncdc.noaa.gov/billions. The website tracks all major natural disasters since 1980 that have had a major economic impact. The database records the date, place, deaths and total cost (NOAA, 2017). From 1980 until July 2017 NOAA recorded 212 disasters with a combined economic cost of over US$ 1.2 trillion.

NOAA data, shown in Figure 1, visually and statistically reveal a rising number of billion dollar natural disasters over time. In a typical year during the 1980s the U.S. had on average 2.7 major disasters. During the 1990s, the average year had 4.8 disasters. The first decade of the 2000s saw 5.4 major disasters on average. Finally, during the 2010s, a decade which is not finished, the typical year has seen 10.6 disasters whose damage exceeds a billion dollars.

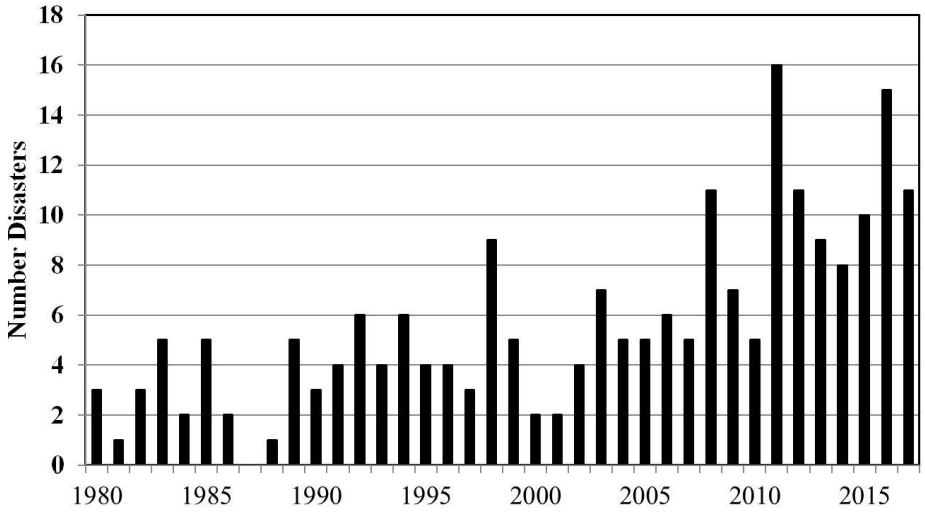

Figure 1: Number of Billion Dollar Disasters from 1980 to 2017.

Notes: Data for 2017 as of September. Information from https://www.ncdc.noaa.gov/billions/time-series

[1] Harvey and Irma both struck areas with large amounts of economic development. Houston MSA's real GDP grew 50%, while the state of Florida's grew 23% from 2001 to 2015.

An OLS regression with year, Y, tracking the trend over time in the number of disasters, D, and with t-statistics in ( ) is

$$D = -482.9\ (6.4) + 0.244\ (6.5) \times Y. \qquad R^2 = 0.54,\ N = 38.$$

Y's 0.244 coefficient shows about one-quarter more disasters occur each year. This means approximately every four years the U.S. gains one additional billion dollar natural disaster.

Taken at face value, this regression suggests the U.S. is facing a rapidly increasing number of disasters. If true, disaster preparedness and support should be dramatically increased. The rest of this article focuses on explaining why the underlying data and this first regression present a biased picture and how adjusted data provide a more realistic view.

2. Data

NOAA's billion dollar disaster database methodology is well thought out. (Smith & Katz, 2013). The data do not cover just one type of disaster like hurricanes. Instead, they track all kinds of large disasters beyond hurricanes such as winter storms, droughts, heat waves, tornados, floods, hail and wildfires (Ross & Lott, 2003). The data even include periods of subfreezing temperatures that destroy billions of dollars of crops and kill large amounts of livestock.

The database also attempts to ensure costs are measured accurately (Smith & Matthews, 2015). The total cost of each event includes both losses covered and not covered by insurance. The losses include damage to buildings, roads and infrastructure, as well as items destroyed within buildings when a major disaster strikes. The figures even include some amounts lost by businesses because they were temporarily forced to shut down. The figures, however, do not assign any value to lives lost. Even if a storm kills hundreds, no adjustment is made for deaths.

The figures are adjusted for inflation using the Consumer Price Index (Bureau of Labor Statistics, 2017). This is important because a billion dollars in 1980 is actually equivalent to $3.15 billion today after adjusting for price changes. Without adjusting for inflation, disasters would consistently look more expensive over time and constantly shatter records for damage.

3. Adjustment and results

Even with the inflation adjustment, a key reason there are more billion-dollar disasters is that the economy is much bigger today than it was in the 1980s. As Pielke et al (2008) point out, when the economy was smaller disasters caused less economic damage since there were fewer homes, factories and office buildings to destroy. Since 1980, the U.S. economy has more than doubled. The economy grew from $6.5 trillion in 1980 to $17 trillion in 2017 as measured by real GDP. To account for this growth the NOAA data must be adjusted for the economy's size.

However, using GDP as an adjustment is problematic since GDP measures production, includes large amounts of services, and does not directly track physical items like the number of buildings

or roads in the economy. GDP figures, however, are part of the National Income and Product Accounts (NIPA), which also track items vulnerable to destruction in a disaster. U.S. NIPA accounts have tracked the "Net stock of fixed assets and consumer durables" since 1925 (Bureau of Economic Analysis, 2003) and publish the figures online at www.bea.gov under the national data heading.

The NIPA database is similar to financial statements issued by businesses. Financial statements include both income statements, which show revenues and costs, as well as a balance sheet, which show assets and liabilities. GDP figures are similar to a nation's income statement, while the stock of fixed assets is similar to the balance sheet.

The net stock of fixed assets includes private sector items like homes, condominiums and other residences. It includes consumer durables like cars, trucks and washing machines. Business assets such as offices, factories, stores and equipment are included. The net stock figures include federal, state and local structures and equipment. Finally, the NIPA accounts depreciate the current stock of fixed assets and durable goods each year so that values are adjusted for wear, tear and obsolescence. One drawback is the figures include intellectual property, which disasters cannot destroy. Intellectual properties comprise around 5% of the net stock so this factor's bias is not large.

Since the NOAA data are already adjusted for inflation, the best fixed asset series to use is called "Chained Fixed Assets." This series shows in index form how much fixed assets have grown after removing the impact of prices changes. The chained data (2009=100) are found online (Bureau of Economic Analysis, 2017) and reproduced in Table 1.

To calculate the adjustment, each year's chained figure is divided by the 1980 chained value and multiplied by $1 billion. The results are in Table 1's columns labeled "New Cutoff." They represent the annual figure that is the minimum amount of damage needed to be economically equivalent to $1 billion of destruction in 1980. For example, the figure for 2007 is $2.1 billion. This means any storm in 2007 that caused less than $2.1 billion in damage would not have been economically important enough to make the billion dollar list using the 1980 standard.

The number of major disasters was then recalculated using the new cutoffs and the results are seen in columns marked "Adjusted Number Disasters." Rerunning the OLS regression using the adjusted values results in

$$D = -121.75\ (2.05) + 0.063\ (2.11) \times Y. \qquad R^2 = 0.11,\ N = 38.$$

The 0.063 coefficient on Y is much lower than the 0.244 value in the unadjusted regression. The 0.063 figure means since 1980 the country gained approximately one additional billion dollar disaster every sixteen years, which is much less than every four years. The adjusted regression's lower R^2 and t-statistics also provide less support for a steadily increasing trend in the number of disasters.

Table 1

Original Number of Billion Dollar Disasters, Adjusted Cutoff in Billions and Adjusted Number of Disasters

Year	Original Number Disasters	Chained Fixed Assets	New Cutoff in Bill.	Adjusted Number Disasters	**Year**	Original Number Disasters	Chained Fixed Assets	New Cutoff in Bill.	Adjusted Number Disasters
1980	3	46.6	$1.00	3	**1999**	5	77.7	$1.67	3
1981	1	47.8	$1.03	1	**2000**	2	80.5	$1.73	1
1982	3	48.7	$1.05	3	**2001**	2	83.0	$1.78	2
1983	5	49.9	$1.07	5	**2002**	4	85.3	$1.83	2
1984	2	51.5	$1.11	1	**2003**	7	87.7	$1.88	5
1985	5	53.3	$1.15	5	**2004**	5	90.2	$1.94	4
1986	2	55.2	$1.18	2	**2005**	5	92.7	$1.99	4
1987	0	57.0	$1.22	0	**2006**	6	95.3	$2.05	2
1988	1	58.7	$1.26	1	**2007**	5	97.7	$2.10	4
1989	5	60.3	$1.29	4	**2008**	11	99.3	$2.13	5
1990	3	61.8	$1.33	3	**2009**	7	100.0	$2.15	1
1991	4	62.9	$1.35	3	**2010**	5	100.8	$2.16	3
1992	6	64.1	$1.37	5	**2011**	16	101.8	$2.18	10
1993	4	65.4	$1.40	4	**2012**	11	103.0	$2.21	8
1994	6	66.9	$1.44	5	**2013**	9	104.4	$2.24	2
1995	4	68.6	$1.47	4	**2014**	8	106.0	$2.28	3
1996	4	70.5	$1.51	4	**2015**	10	107.8	$2.31	4
1997	3	72.6	$1.56	2	**2016**	15	109.4	$2.35	8
1998	9	75.0	$1.61	6	**2017**	10	110.0	$2.36	3

Note: Chained fixed asset value for 2017 is author's estimate.

4. Conclusion

There are many ways of tracking the magnitude of natural disasters beyond using economic measures. This research also ignores the cost of potentially crucial ecological and environmental damage. Nevertheless, if an economic measure is used then NOAA's raw data must be adjusted to account for the growing value of infrastructure, buildings and durable goods. NOAA's unadjusted data suggest a growing frequency in the number of natural disasters. Adjusting for economic growth, however, shows while the problem is increasing, it is growing more slowly than reported.

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