COPING WITH ECONOMIC AND ENVIRONMENTAL SHOCKS: INSTITUTIONS AND OUTCOMES‡:

Moving to Higher Ground: Migration Response to Natural Disasters in the Early Twentieth Century†

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Natural disasters cause significant loss of life and property damage. In 2005, Hurricane Katrina destroyed large sections of New Orleans, resulting in the death of thousands. This salient disaster highlights the fact that millions of people choose to live in geographical areas that are at risk of natural disasters. In fact, the attraction of coastal living has encouraged more people to move to areas at risk from hurricanes and flooding, resulting in greater economic costs of disasters over time (Rappaport and Sachs 2003; Kahn 2005; Pielke, Jr. et al. 2008). Many forecasters predict that climate change will only exacerbate these risks.

Exposure to natural disaster risk is a function both of an individual's private choices and of governmental decisions over land use zoning and infrastructure investment. Government actions intended to protect the public can reduce the incentive to engage in private self-protection. An intuitive example of such "crowding out" is the building of new sea walls in New Orleans. More people will stay in or move to a risky area if they believe that sea walls will be built. In this case, government investment can displace self-protection against risk (Peltzman 1975; Kousky, Luttmer, and Zeckhauser 2006). Such efforts could be disastrous if the public is overly optimistic about engineers' ability to protect the public.

In this paper, we examine one form of private self-protection, net migration away from disaster-struck areas, during the 1920s and 1930s, a period before the advent of coordinated federal disaster management. In this era, disaster relief was directed by the American Red Cross (ARC). We use ARC documents to compile all major natural disasters from 1920 to 1940, including floods and tornadoes, the most common types of disaster events, and

earthquakes and hurricanes. We measure migration activity using two new panel datasets of Census sources, the first following individuals from 1920 to 1930 and the second tracking location from 1935 to 1940. We find that, on net, young men move away from areas hit by tornadoes but are attracted to areas experiencing floods. One explanation for this difference is that early efforts by the Army Corps of Engineers to protect against future flooding may have counteracted the private migration response to flood activity.

Migration away from tornado-struck areas is consistent with Hornbeck (forthcoming), which documents out-migration from the Dust Bowl in the mid-1930s. This historical pattern is in sharp contrast to Deryugina (2011), which finds no net population change in counties struck by hurricanes in the 1980s and 1990s. Instead, affected counties receive $356 (2008 dollars) per capita in immediate disaster aid and $670 per capita in additional federal transfers over the next 10 years. The paper speculates that these federal transfers may create moral hazard encouraging households to stay in risky areas.[1] An unintended consequence of the growth in disaster relief and government investment in protective infrastructure may have been to expose more people to risk as they chose to move to (or not to leave) disaster-prone areas.

I. Data on Natural Disasters and Migration Activity, 1920–40

A. Data on Natural Disasters

The 1920s and 1930s witnessed numerous major natural disasters.[2] Deadly tornadoes ravaged Missouri, Illinois, and Indiana in 1925, and Mississippi and Georgia in 1936; a 6.4-magnitude earthquake struck near Long Beach, California in 1933; massive flooding affected the lower Mississippi valley in 1927 and the Ohio and Mississippi river valleys in 1937; and serious hurricanes hit Florida in 1926 and 1928 and New England and New York in 1938.

Figure 1 portrays the combined damage estimates for all major disasters in the United States from 1902 to 1978.[3] Following Pielke, Jr. et al. (2008), we use the GDP deflator to convert damage estimates into constant 2005 dollars. The real series is then "normalized" over time by comparison with real value estimates of national wealth. The year 1906, which witnessed the great San Francisco earthquake, is an obvious outlier. Three of the ten years in which natural disasters destroyed more than 0.1 percent of national wealth occurred in one of our study periods (1935–40).

We collect data on disaster activity by county and year from a series of ARC circulars. The ARC received its first congressional charter in 1881 as a voluntary nonprofit organization providing assistance to victims of disasters and wars.[4] During World War I, the ARC became a mass organization, with over 20 million members and nearly 4,000 local chapters.

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[1]In contrast, Gregory (2011) finds little response to variation in the generosity of federal rebuilding funds after Katrina because so few residents of New Orleans were on the margin of leaving the city.

[2]Among the popular and academic books chronicling these disasters are Barry (1997); Egan (2006); Welky (2011); Burns (2005); and Libecap and Steckel (2011). In addition, 1930 and 1934–36 witnessed wide spread droughts as documented in Cunfer (2005); Woodruff (1985); and Hornbeck (forthcoming).

[3]For data on floods, see US Weather Bureau (1950, Table F4, pp. 75–76); and Pielke, Jr., Downton, and Miller (2002); for earthquakes, see Vranes and Pielke, Jr. (2009); for hurricanes, see Pielke, Jr. et al. (2008); and for tornadoes, see Brooks and Doswell III (2000).

[4]This short history of the American Red Cross is based on Hurd (1959) and American National Red Cross (1955).

The organization provided support for immediate relief and rehabilitation after disasters; funds and supplies were gifts, offered neither on credit nor as insurance compensating for realized losses.

As part of its campaign to solicit donations of money and volunteer work during the 1920s and 1930s, the national organization published a series of circulars documenting its disaster relief efforts. The circulars typically described the origin and scope of the emergency, painted a human picture of its victims, and detailed the agency's response. An especially useful feature of the documents is their precise accounting of the affected area at the county level, the number of victims and extent of property damage, and the amount of relief provided.

The coverage of the circulars correlates well with other authoritative lists of major natural disasters during the interwar period. For example, the ARC circular dataset capture every fatal flood event reported in the US Weather Bureau's list of "Losses in Individual Severe Floods in the United States since July 1902" (except the Texas floods of 1921); every deadly earthquake appearing on the list of significant earthquakes in Vranes and Pielke (2009);[5] all of the major hurricanes and many of the lesser storms in Piekle, Jr. et al. (2008); and all of the major tornadoes in Brooks and Doswell (2000).[6]

The geographic incidence of disasters is highly uneven. Figure 2 maps the count of natural disasters in the 1930s from our ARC dataset by State Economic Area (SEA), a geographic unit made up of counties or collections of counties. We conduct our analysis at the SEA level, which is the finest geographic unit available in the 1940 Integrated Public Use Microdata Series (IPUMS) (Ruggles et al. 2010); 68 percent of SEAs experienced at least 1 natural disaster in the 1930s. Of these, nine percent of SEAs suffered from four or more disasters; these high-intensity disaster areas were concentrated in the flood plain of the Mississippi river.

B. Migration Data

Our outcome of interest is migration into and out of disaster-struck areas. We measure migration activity using two panel datasets that follow one set of individuals from 1920 to 1930 and another from 1935 to 1940. Our sample focuses on prime-age men who were between the ages of 30 and 40 at the end of the migration period, a group that typically has high mobility rates. One important advantage of our panel data is that we are able to observe both in-migration to an area and out-migration of existing residents, rather than simply measuring net changes in population. With this data, we are able to test whether an asymmetry exists in the response to natural disasters between incumbents, who have established social networks and may have developed skills for coping with local shocks, and

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[5]The ARC data also correspond well to the fatal earthquakes on the more extensive US Geological Survey (2012) list. The only fatal quakes from the USGS list that are missing from the ARC list are Santa Barbara, CA in June 1926 (1 dead), Eureka, CA in June 1932 (1 dead), and Kosmo, UT in May 1934 (2 dead).
[6]Major hurricanes are defined as those causing $30 million in damages (based on 2005 purchasing power). Brooks and Doswell III (2000) define "a major tornado" as one that "either killed at least 20 people or had an inflation-adjusted damage total of at least $50 million in 1997 dollars, or both." ($50 million in 1997 translates to about $61 million in 2005 dollars.)

outsiders who are considering moving to an area but have limited information or knowledge about coping strategies.

For the 1935 to 1940 period, our measure of migration relies on a question in the 1940 census that asks respondents where they lived five years before. We partition the country into 467 SEAs. The implied decadal migration rate between SEAs is 26 percent. We build a comparable dataset for the 1920s by matching young men by first and last name, age and place of birth (state or country) between the 1920 IPUMS sample and the 1930 census manuscripts.[7] Because most false matches will be coded erroneously as migrants, we conservatively require all successful matches to be unique by name and place of birth within a 5-year age band (+12/−12 years around the 1920 age in 1930). We match 24 percent of men who are unique by name, age, and place of birth in 1920, which is comparable with the existing literature (Ferrie 1996). We know county of residence in 1920 and 1930 for all successful matches; for consistency across time periods, we aggregate counties to the SEA level. Forty-eight percent of our matched sample migrated across SEAs in the 1920s. By this measure, the migration rate is almost twice as high in the 1920s than in the 1930s, a pattern due both to higher mobility in the prosperous 1920s and some likely misclassification of migrants due to our matching procedure.

II. Estimation Strategy and Results

A. Conditional Logit Models of Migration

Susceptibility to natural disasters is one feature of an area that individuals take into account when making location choices. Imagine a simple model of location choice in an open system of cities with no migration costs. If everyone has identical preferences defined over location-specific attributes such as unemployment risk and real earnings (net of housing prices), basic hedonic compensating differentials theory predicts that wages and rents will adjust across geographical areas to sketch out the representative agent's indifference curve (Rosen 2002). If an area faces higher natural disaster risk, and this is common knowledge, then real wages will be higher and rents will be lower to compensate individuals for locating in such a risky area.

In reality, the assumptions in the simple model sketched above are unlikely to hold. For example, individuals face migration costs. In addition, people are not fully informed about the natural disaster risk facing different regions of the country, particularly in the 1920s and 1930s, when national information was less readily available.[8] In this sense, recent natural disasters were likely to be "new news" in this period. Rational expectations studies of local labor markets, such as Topel (1986), highlight that migrants respond to shocks that are unexpected and are more likely to move if they believe that the shock is permanent.

A disaster event bundles together new information about local risks, damage to short-run quality of life, and perhaps a positive shock to labor demand due to rebuilding and new construction. To study how recent disasters affect migration patterns, we estimate an

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[7]Names are standardized for orthographic differences using the NYSIIS algorithm. We also match an oversample of disaster-struck counties.
[8]Only 37 percent of American households had a radio in 1930.

augmented version of a standard migration model that embodies gravity effects (that is, distance from one's origin location to every possible SEA destination) and other SEA attributes such as climate and local labor market opportunities. Our innovation is to introduce measures of recent disaster shocks as additional place-based attribute.

In particular, we estimate a series of conditional logits for the 1920s and 1930s, the outcome of which is an indicator variable that equals one if the individual chooses to live in SEA j. For illustration, equation (1) presents our estimating equation for the 1935 to 1940 time period for a man who lived in SEA l in 1935. In this equation, Z is a vector of attributes of some potential location SEA j, $Dist$ is the mileage distance between SEA l and SEA j and $Disasters$ is a vector of disaster counts for SEA j in the previous decade:

$$\Pr(\text{choose } j \text{ in } 1940 | \text{in } l \text{ in } 1935) = \frac{\exp(B_1 Z_j + B_2 \text{Dist}_{jl} + B_3 \text{Disasters}_j)}{\sum_{m=1}^{467} \exp(B_1 Z_m + B_2 \text{Dist}_{ml} + B_3 \text{Disasters}_m)}.$$

The main explanatory variable of interest is a count of disaster events by type in the SEA over the previous decade. Disaster types include earthquakes, hurricanes, floods, and tornadoes. In some specifications, we also include disaster counts in the previous decade as a measure of baseline risk against which recent disasters may reflect "new news."[9]

Other SEA-level controls included in the Z vector are the logarithm of total population and of land area; the black population share; a quadratic in latitude and in longitude, which captures variation in temperature and other climatic conditions; a dummy variable equal to one for SEAs with some coastal exposure; and a proxy for current and lagged decadal employment growth. Control variables are measured in the base year. Following Bartik (1991), our proxy for employment growth uses base-year industrial composition of employment in the SEA to weight national trends in employment growth by industry. We also include a quartic in distance between SEA j and all other possible SEA locations l.

B. Results

Table 1 reports the odds ratios of living in or moving to an SEA facing a natural disaster as derived from our conditional logit estimation. Tornadoes and floods are the two most common types of natural disasters. We find that the population is up to 5 percent less likely to locate in SEAs that experienced a recent tornado, while residents are up to 15 percent *more* likely to be found in a flooded SEA. These patterns are driven by a combination of out-migration of existing residents and in-migration of new arrivals. In columns 3 and 5, we reestimate the conditional logit for samples of men who moved between SEAs, allowing us to focus on factors that affect the decision to migrate into an SEA. We continue to find that in-migrants are attracted to flooded areas and shy away from areas recently hit by a tornado. In-migrants appear to be more responsive in avoiding tornado activity than are existing residents.

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[9]In ongoing work, we estimate hedonic wage and housing price regression models using the 1940 IPUMS sample. We find that each natural disaster event reduced housing prices by a statistically significant four percent.

The migration response to floods and tornadoes is notably similar across the two time periods, despite differences in data construction. We hesitate to interpret the observed response to hurricanes and earthquakes given their rarity. For example, in the 1920s, the observed migration response to hurricanes is likely picking up rapid in-migration to Florida for other reasons. For brevity, coefficients on the other controls are not shown. These controls show that, as today, migrants in the 1920s and 1930s were attracted to areas with higher current and lagged local-labor demand. Migrants also sought warmer winters and cooler summers.

The disparity in the migration response to floods and tornadoes is consistent with nascent public efforts at flood control beginning in the 1910s. Following the Great Mississippi Flood of 1927, Congress passed the Flood Control Act of 1928 authorizing the Army Corps of Engineers to construct an extensive system of levees. Similarly, in response to the 1937 flood of the Ohio and Mississippi river valleys, the federal government commissioned a series of storage reservoirs to prevent future flooding. Although these infrastructure projects were targeted at areas with high population density, they may have also reduced the flood risk associated with the fertile farm land proximate to the river valleys. In contrast, in this period, tornadoes were associated with high fatality especially because localities had yet to install early warning systems (Simmons and Sutter 2011).

III. Conclusion

This paper has investigated the role of natural disaster shocks in determining gross migration flows, controlling for other place-based features. Using two micro datasets, we documented that in the 1920s and 1930s population was repelled from tornado-prone areas, with a larger effect on potential in-migrants than on existing residents, while flood events were associated with net in-migration. The differential migration responses by disaster type raises the question of whether public efforts at disaster mitigation counteract individual migration decisions. The nascent investment in rebuilding and protecting flood-prone areas could provide one example of public investment crowding out private self-protection (i.e., migration).

In future work, we plan to explore the role of New Deal disaster management more directly by exploiting variation across SEAs in federal expenditures and representation on key congressional committees. We predict that residents of areas that received federal largesse after a disaster in the 1930s will be less likely to move out and that new arrivals may be more likely to move in, while residents of areas that benefited less from New Deal spending will continue to use migration as a means of self-protection.

Acknowledgments

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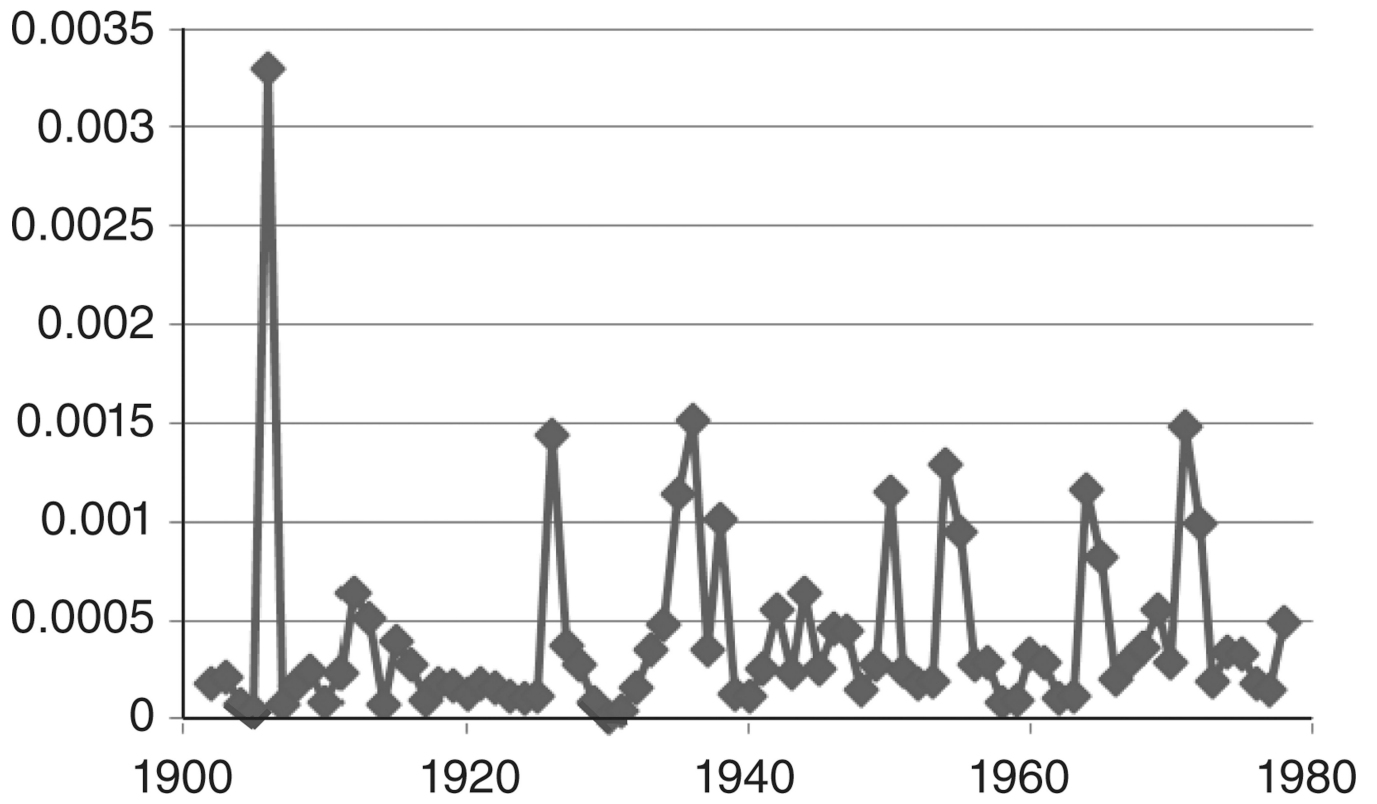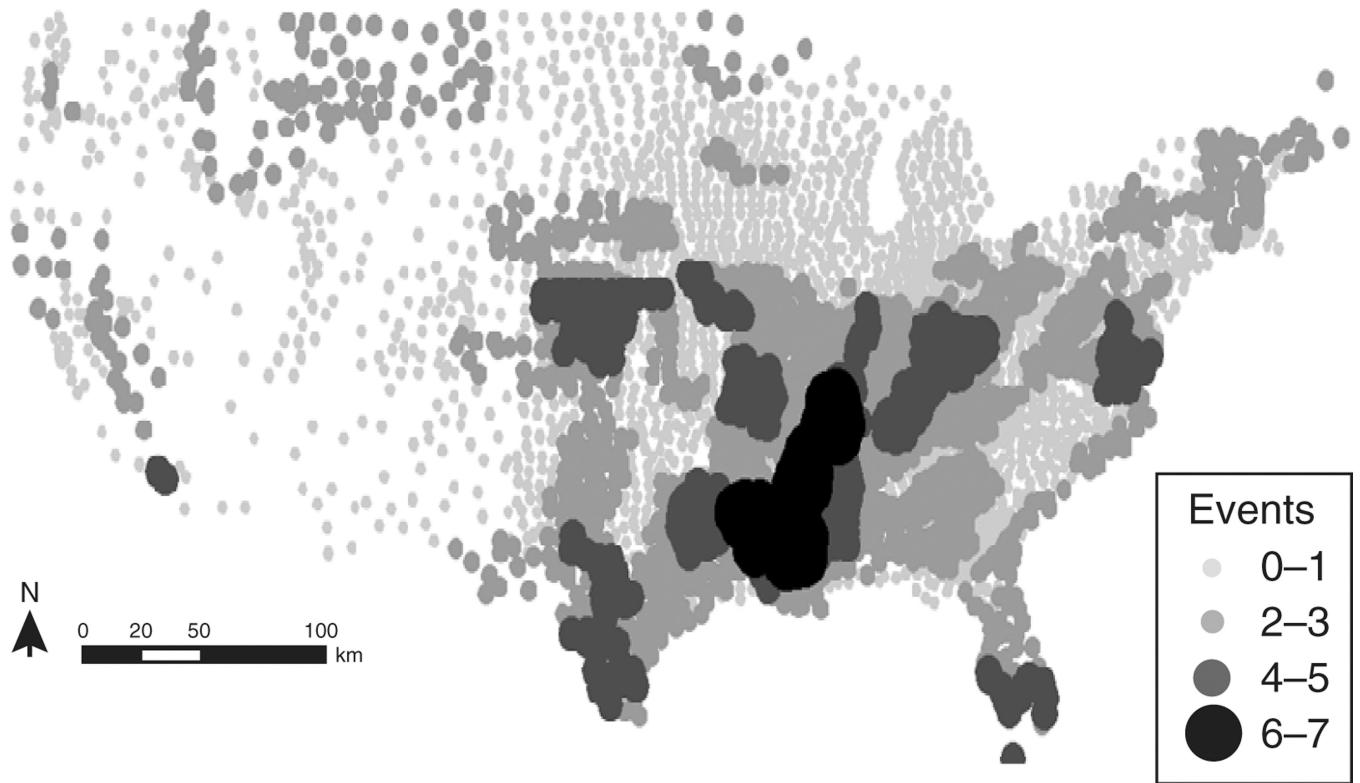
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Figure 1.
Total Damages from Earthquakes, Tornadoes, Hurricanes, and Floods Share of National
Wealth, 1902 to 1978

Figure 2.
Count of Natural Disasters by State Economic Area, 1930–40

Table 1

Effect of Natural Disasters on Location Choice, Odds Ratios from Conditional Logit Models, 1920–40

	Num. SEAs, 1920–30	1920–30 Full sample	1920–30 Movers only	1935–40 Full sample	1935–40 Movers only
Flood count	95	1.150 (10.28)	1.065 (2.92)	1.076 (4.05)	1.030 (2.22)
Tornado count	48	1.010 (0.46)	0.997 (−0.08)	0.964 (−2.05)	0.860 (−8.88)
Hurricane count	5	1.378 (3.93)	1.466 (5.01)	0.907 (−3.24)	1.028 (0.98)
Earthquake count	5	0.947 (−0.70)	0.877 (−1.21)	0.997 (−0.14)	0.997 (−0.16)
Controls		Yes	Yes	Yes	Yes

Notes: Column 1 reports the number of SEAs (out of 467) affected by each disaster type in the 1920s. For columns 2–5, cells report odds ratios from conditional logit models with *z*-statistics in parenthesis. Other controls (not reported) include the logarithm of total population and of land area; the black population share; a quadratic in latitude and in longitude; a dummy variable equal to one for SEAs with some coastal exposure; a proxy for employment growth in the SEA; total disaster count in the previous or subsequent decade; and a quartic in distance between the SEA of origin and the current SEA. Columns 2 and 5 restrict the sample to men who moved away from their origin SEA. All estimations are based on 15,000 randomly selected men.