

The Effect of Disasters on Migration Destinations: Evidence from Hurricane Katrina

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Abstract While post-disaster migration can move vulnerable populations from dangerous regions to relatively safe ones, little is known about decisions that migrants use to select new homes. We develop an econometric model of migrant flows to examine the characteristics of the destinations that attracted migrants leaving the New Orleans area following Hurricane Katrina in 2005 relative to migration behaviors in other years. We find an increased flow of migrants to large, nearby counties with a mixed effect of economic variables on migration. We find that counties that had experienced fewer disasters received a greater proportion of total migrants in 2005, but there was an overall increase in migration flow to disaster-prone regions as well.

Keywords Post-disaster migration · Hurricane Katrina · Pull factors

Introduction

Natural disasters can cause widespread destruction and weaken local economies. These impacts can lead to permanent migration away from disaster-affected areas. Such permanent, or even temporary, migration induced by natural disasters has the potential to significantly reshape the distribution of national and global populations and economies

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(McIntosh 2008). Moreover, because migration moves people out of the path of some disasters, and potentially into the path of other ones, post-disaster migration has implications for the risks associated with future events (Gráda and O'Rourke 1997). Finally, the migration itself and the loss of community cohesion suggests the need for considerations, such as mental health support, in communities that will receive large numbers of disaster migrants (Weber and Peek 2012).

Migration following disasters has been studied extensively for major events like Hurricane Katrina, the 2011 Tohoku earthquake/tsunami and subsequent Fukushima nuclear disaster, and the 2004 Indian Ocean tsunami. Because of the pressures placed on the affected population, disasters can cause migration among a wider portion of the population than those who migrate normally – i.e. in a non-disaster context (Gray et al. 2014). While the propensity for disaster-affected populations to migrate is documented, less is known about the preferences that impact the destination of disaster migrants.

Influences on migration decisions are generally framed in the context of “push” factors and “pull” factors. Push factors cause people to want to leave the origin, while pull factors cause people to want to go to a specific destination. For example, high unemployment in the origin signals poor job prospects and is seen as a push factor for out-migration. Similarly, a low cost of living might pull people toward a particular destination.

The circumstances of a disaster, however, may shift the relative importance of various pull factors in attracting migrants. This could occur because preferences over these factors are dependent on the conditions in which the decision to migrate is made. Alternatively, a disaster induces traditional non-migrants to move, and, if these people have different preferences than those who are traditional movers, then the overall destination of post-disaster migrants will shift.

An understanding of these pull factors is important for crafting natural disaster recovery policies, understanding the likely evolution of disaster damages, and evaluating the prospects for repatriation. For example, if post-disaster migrants are unable to move to the optimal location due to costs associated with migration, government subsidies for relocation costs might be justified. If post-disaster migrants move to other areas that are at high risk of natural disasters, then the relocation costs will not mitigate future disaster losses and may actually increase future social costs.

Hurricane Katrina, which struck New Orleans in 2005, provides an ideal case study to examine the factors that influence the destination of disaster migrants. Most residents of New Orleans evacuated prior to the Hurricane, and following the storm most remaining residents were evacuated by the Federal Emergency Management Agency (FEMA). All together, approximately 1.5 million people evacuated the New Orleans area which accounted for approximately 96% of New Orleans residents and 80% of residents surrounding the city (Groen and Polivka 2008; Elliott and Pais 2006). While a large number of evacuees were initially relocated to Houston by FEMA, Katrina evacuees relocated throughout the country. Nearly every state received FEMA funding for costs associated with supporting evacuees from Katrina.

Permanent migrants – as opposed to migrants that eventually returned to the New Orleans area – were generally younger, more likely to have children, and more likely to be black (Groen and Polivka 2010). There was also an increased flow of migrants from neighboring communities in the years following Katrina compared to the years prior to Katrina indicating that the migrants which relocated to nearby communities were more likely to return than those further away (Fussell, Curtis, and DeWaard 2014).

In this paper, we examine the migration pull factors in terms of characteristics of the destinations of post-Katrina migration out of the New Orleans area by using data on the movement of IRS return filings between counties and a range of county-destination attributes. This paper contributes to the literature by estimating the relative importance of a range of factors in post-disaster relocation decisions. This work conveys a range of policy implications surrounding disasters and climate change. By identifying the characteristics that draw migrants following natural disasters, we increase the understanding of future migration patterns as disasters grow more frequent. Our consideration of distance in the relocation decision also highlights the extent to which post-disaster migrants will be removed from similarly disaster-prone areas.

The rest of the paper proceeds as follows. In “[Conceptual Underpinnings](#)”, we review the theoretical structure of migration decisions, in “[Data](#)” discuss our data sources, in “[Methods](#)” present our estimating equations, and in “[Results](#)” present our results.

Conceptual Underpinnings

From an economic standpoint, migration decisions are based on households comparing their expected lifetime utility in their current location (the origin) to a location to which they could move (the destination) (Greenwood 1985, 1975). Yun and Waldorf (2016) examine the decision about whether or not to migrate in an expected lifetime utility framework and focus on the extent to which Katrina induced migration by those who would not otherwise have migrated. The utility that a household expects to receive from living in a particular location depends on economic variables such as the wages and cost-of-living associated with an area, but also on non-economic variables such as environmental amenities, family and social ties, and perceptions about safety. A household will decide to migrate if the increase in expected lifetime utility obtained by moving from the origin to the destination exceeds the costs of moving. These costs include the financial costs associated with moving, as well as more abstract factors such as the social costs incurred by the move.

The decision to migrate is generally endogenous to migrant characteristics. Highly-skilled migrants who expect to receive large wage premiums are more likely to migrate than low-skilled workers (Borjas 1987). Similarly, migration is costly. Chiswick (1999) notes that those who are less credit-constrained are more able to afford the upfront costs associated with an optimal relocation decision.

Natural disasters, however, cause exogenous variation in the expected lifetime utility at the origin. For example, property damage would require repair costs in order to stay at the origin, and a weakened local economy would lower wages at the origin. Similarly, if a disaster causes households to update their beliefs about the likelihood and severity of subsequent events, this could lower the expected utility of remaining in the origin. These effects would cause households to re-evaluate their location decisions and potentially choose to migrate due to the decreased expected life-time utility at their origin (Yun and Waldorf 2016).

In the event of major natural disasters like Hurricane Katrina and the Fukushima nuclear disaster the push factors are relatively obvious – people leave the origin because of mandatory evacuation requirements, legal inability to return due to quarantines, loss of employment opportunities, etc. It is less obvious what draws migrants to particular locations following a disaster. One might be particularly concerned that post-disaster migrants are systematically different than those who choose to migrate under other circumstances.

Disaster-related migrants, for example, might feel compelled to relocate more quickly or have less wealth with which to bear moving costs. Hence, they may not move to optimal locations in comparison to normal circumstances, or what Yun and Waldorf (2016) refer to as “double-victimization.” Black et al. (2011) suggest that population movements due to disasters are typically short distance, though this conclusion seems to be counter to what happened in the aftermath of Hurricane Katrina.

Several variables have been suggested, and some tested, to explain the pull factors. Many of these are traditional in the gravity model literature of migration, such as wage and cost-of-living differentials, distance, moving costs, and general economic health of the destination (Borjas 1987; Rupasingha, Liu, and Partridge 2015). Broadening the analysis leads to consideration of amenities, family ties, racial/ethnic affinities, migration networks, and institutions (McKenzie and Rapoport 2010; Nifo and Vecchione 2014). The destination choice itself is dependent on the reason that drives the individual to migrate (Findlay 2011). One might conclude that short or long-run hazard vulnerability would be major considerations, but Black et al. (2011) and Fielding (2011) emphasize the primacy of socioeconomic over environmental variables in current migration decisions, though on the basis of only anecdotal information.

Such migration preferences need not be constant, however. The very push-factors that cause migrants to choose to move could shift their relative preferences for pull factors. For example, a hurricane that destroys residents’ homes (a push-factor shock) could cause people to rethink their preferences over living in coastal communities. Similarly, because natural disasters can force rapid relocation rather than providing time to search for new jobs or save money for transportation costs, migrants may sacrifice some pull factor preferences for a quicker transition.

Data

Our primary source of data is the Internal Revenue Service (IRS) Statistics of Income Division’s migration data (Internal Revenue Service 2017). These data are based on year-to-year address changes reported on individual income tax returns filed with the IRS and aggregated up to the county level beginning in 1990. The data reports county-to-county flows of households, people, and income as proxied by number of returns filed, number of personal exemptions claimed, and total adjusted gross income. The county-to-county flows can be seen as either inflows or outflows depending on the county of interest. The IRS suppresses observations with fewer than 10 filers due to disclosure concerns and prior to 2004 the IRS did not distinguish between a non-disclosed observation and a true 0 observation. Because we cannot distinguish between a county-to-county pair which received between 1 and 9 filers from a county-to-county pair which did not receive any filers, we treat these potential non-disclosed counties as 0.

The IRS data come with a few limitations. For one, the sample is based upon tax filers who have completed their tax filings by late September of the following year. Individuals filing beyond this time are typically higher income earners, although 95 to 98 percent of the tax filing population complete their tax filings by the September date. Another limitation is that the data do not include individuals that do not file income taxes – and thus non-income individuals will be under-counted in migration data. And finally, the IRS data classifies a filer as a migrant based upon their filing addresses on record for consecutive tax years being in different counties. The movements are thus annual in nature and intrayear moves cannot be identified. In the context of our study, an additional limitation is that we do not observe

the month of migration, so we can not disambiguate between people who left New Orleans in 2005 between January and August and those who left after Hurricane Katrina. However, we note that under the assumption that January-August migration was comparable in 2005 to January-August migration in other years, these effects will not impact inference.

Given our focus on New Orleans, we restrict our interest to outflow migration from the parishes most severely affected by Hurricane Katrina in 2005. We define the population affected by Hurricane Katrina as those residing in Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. John The Baptist, St. Tammany, and Terrebonne Parishes.¹ These parishes constitute the New Orleans metro, as well as two surrounding Parishes which adjoin the metro area. While there was some migration between affected regions (i.e., moving from a county that was severely affected to one that was slightly less affected), we remove these migrants from our sample to facilitate a simpler interpretation of outflow migrants.²

We aggregate annual migration flows to each destination county across the 9 highly-affected origin counties between 2000 and 2010. The result is an 11-year panel of population flows to the 3,095 destination counties.³ There is a non-zero number of migrants to approximately 5.4% of the county-year observations in our dataset. In 2005, however, 13.8% of US counties received migrants from the affected area. With the exception of 2005, the number of migrants and the proportion of counties that receive migrants from New Orleans is relatively consistent over time.

Most migrants from the New Orleans area move to counties that are relatively close. Tables 1 and 2 present the states and counties that received the greatest proportion of migrants from the New Orleans area. In each case, we present the number and proportion of migrants in 2005 and the average value across all other years (2000-2004, 2006-2010). Unsurprisingly, the total number of migrants from the New Orleans area was much higher in 2005 than in other years. Large, economically-prosperous, but distant, states like California and Florida received a lower proportion of migrants in 2005 than they did in other years. At the county-level, we again see increases in the proportion of migrants who move to counties in Texas at the expense of intra-Louisiana migration.

We supplement the IRS migration data with a number of explanatory variables that might affect the relative attractiveness of a destination county. Unemployment rates are obtained from the Bureau of Labor Statistics (BLS) which reports annual labor force data by county (Bureau of Labor Statistics 2017a). This data includes the number of people in the labor force as well as the number of unemployed people, and unemployment rates are calculated from these values. Average annual wage data are obtained from the Quarterly Census of Wages provided by the BLS (Bureau of Labor Statistics 2017b). Both of these variables proxy for the labor market of a given county with the availability of jobs and their relative pay. Median monthly rents for 2-bedroom units are obtained from the Department of Housing and Urban Development (2017). Rents are a measure of cost-of-living for a county. The metropolitan classification of each county is denoted using the United States Department

¹While Louisiana is organized into parishes rather than counties, we will use the term counties throughout this paper to facilitate discussion of destination locations.

²Inclusion of the counties affected by Hurricane Katrina into the dataset would result in an increased preference for close destinations in non-hurricane years but a decreased preference for close destinations in 2005. This would falsely suggest that migrants do not care about distance after disasters, when the decrease in migration is actually driven by a change in the attractiveness of the nearby counties.

³There are 3,144 counties and county equivalents in the U.S. and affected counties are removed from the set of potential destination counties as well as any counties for which explanatory variables are unavailable.

Table 1 Most common state destination for migrants in 2005

State	Migrants in 2005	Percentage of total in 2005	Average migrants	Percentage of total
Texas	73,252	40.3%	5,478	23%
Louisiana	45,014	24.8%	8,604	36%
Georgia	14,480	7.96%	1,126	4.72%
Mississippi	10,327	5.68%	2,386	10%
Florida	5,951	3.27%	1,437	6.02%
Tennessee	4,896	2.69%	389	1.63%
Alabama	4,220	2.32%	587	2.46%
California	3,221	1.77%	992	4.16%
Arkansas	2,728	1.5%	95	0.396%
North Carolina	1,704	0.937%	263	1.1%

of Agriculture Economic Research Service's county-classification for metro and non-metro counties (United States Department of Agriculture Economic Research Service 2017). This is a dummy variable that takes on a value of one if the county does not correspond to a metro area and a value of zero if it is in a metro area. Finally, in order to measure each county's general exposure to disasters, we count the number of disasters for which a county received FEMA aid between 1964 when FEMA began consistently reporting aid by county and 1999 (Federal Emergency Management Agency 2017). This results in a time-invariant measure of disaster risk for each possible destination county that, while simple, is able to incorporate a wider set of disaster types than modeled risk measures like HAZUS.

Summary statistics for the relevant variables are provided in Tables 3 and 4. This table values across the entire 11 year sample, so, that for variables that change over time (percentage black, migrants from New Orleans, average monthly rent, average annual pay, population density, population, and unemployment rate) values reflect the mean, standard deviation, minimum, and maximum across county-years. In the case of variables that do not change over time (number of disasters, metro status, and distance from New Orleans), the values correspond to the mean, standard deviation, minimum, and maximum across counties.

Methods

In order to understand how Hurricane Katrina affected migration we estimate a series of models of migration outflow from the affected counties. We adopt a model of migration in the spirit of a gravity model, in which migration flows depend on travel distance and on the difference in amenities in the origin and in the destination:

$$Y_{i,t} = \alpha + \gamma D_i + \beta_1 P_{i,t} + \beta_2 Katrina_t + \beta_3 \mathbf{X}_{i,t} + \gamma_k D_i \times Katrina_t + \beta_{1k} P_{i,t} \times Katrina_t + \beta_{3k} \mathbf{X}_{i,t} \times Katrina_t + \varepsilon_{i,t} \quad (1)$$

where i indicates destination county, t denotes the year of interest, $Y_{i,t}$ is our dependent variable which captures migration flows from our previously defined New Orleans area, D_i is the Euclidean distance from the centroid of a county to the affected area, $P_{i,t}$ is a measure of population, $Katrina_t$ is an indicator for whether or not an observation corresponds to

Table 2 Most common county destination for migrants in 2005

FIPS	County	State	Migrants in 2005	Percentage of total in 2005	Average migrants	Percentage of total
48201	Harris	Texas	38,033	20.9%	2,512	10.5%
22033	East baton rouge	Louisiana	14,291	7.86%	2,188	9.17%
48113	Dallas	Texas	9,971	5.48%	648	2.72%
48439	Tarrant	Texas	5,575	3.07%	464	1.94%
22105	Tangipahoa	Louisiana	4,758	2.62%	1,685	7.06%
22055	Lafayette	Louisiana	3,377	1.86%	765	3.2%
48029	Bexar	Texas	3,114	1.71%	239	1%
22005	Ascension	Louisiana	2,912	1.6%	762	3.19%
13089	Dekalb	Georgia	2,783	1.53%	250	1.05%
47157	Shelby	Tennessee	2,769	1.52%	230	0.963%

Table 3 Summary statistics

Variable	mean	sd	min	max
Percentage black	0.089	0.145	0.000	0.865
Number of disasters	5.982	3.067	1.000	21.000
Distance (Hundreds of Kilometers)	13.662	7.788	0.573	69.167
Migrants from New Orleans	11.652	248.566	0.000	38033.000
Average monthly rent (Hundreds of USD)	5.596	1.724	3.230	19.400
In a Metro	0.348	0.476	0.000	1.000
Average annual pay (Thousands of USD)	29.553	7.287	0.000	101.084
Population density (1,000 per square mile)	0.179	1.085	0.000	39.121
Population (Millions)	0.074	0.233	0.000	7.422
Unemployment Rate	6.042	2.659	1.367	28.840

2005, and $\mathbf{X}_{i,t}$ contains the relevant economic explanatory variables for destination county: unemployment rate, average annual wages, average monthly rent, percentage of population that is black, an indicator of metropolitan status of the county, and the count of disasters between 1963 and 1999. In the case of each variable except the rural dummy variable, these variables are constructed as the difference between a destination county's value and the average value for the affected New Orleans counties in order to capture the relative changes in New Orleans against the destination counties.⁴

Of particular interest are the coefficients associated with the interactions of the *Katrina*_{*t*} variable indicating whether an observation corresponds to 2005 with the distance and amenity variables. The resulting interaction terms capture the change in preferences over each pull factor variable relative to the other years in our sample, when a major disaster did not strike New Orleans. If Hurricane Katrina shifted the relative importance of pull factors in the destination-selection process, we would expect these interaction terms to be statistically significant. Similarly, if these interaction terms are statistically indistinguishable from zero it suggests that migration was no different in 2005, for example, than it was in years that were not affected by Hurricane Katrina.

We consider a set of dependent variables for our regressions and estimate the model separately with each potential dependent variable. First, we consider the number of migrants to county *i* itself. Next, we consider the inverse hyperbolic sine (denoted IHS) of migrants to county *i*, which is comparable to the natural log and yields semi-elasticities. Next, because many counties receive no migrants at all, we estimate a logistic regression in which $Y_{i,t}$ takes on a value of one if any migrants are observed moving to a particular county in a given year. Finally, we calculate the share of New Orleans' area migration that goes to each county by dividing the flow of migrants to each county by the total number of migrants leaving the New Orleans area.

The first two variables capture the intensive margin of migration, while the third measures the extensive margin. These models describe the distribution and magnitude of post-disaster migration. The final specification speaks to the mix of migration across potential destinations, holding constant the magnitude of migration flows.

⁴We thank an anonymous referee for this suggestion.

Table 4 Summary statistics of key counties

Period	County	State	Population	Percentage black	Unemployment rate	Average pay	Average rent	Metro	Number of disasters	Migrants	distance
Pre	New Orleans	LA	1.124	0.351	6.441	27.652	5.162	1	7.845	NA	NA
Katrina	New Orleans	LA	0.776	0.354	6.294	35.700	6.415	1	9.284	NA	NA
Post	New Orleans	LA	0.980	0.306	5.813	44.629	9.077	1	8.772	NA	NA
Pre	Dallas	TX	1.661	0.211	6.076	45.889	8.220	1	10	496.8	7.166
Pre	E. Baton Rouge	LA	0.302	0.410	5.392	31.375	5.114	1	10	1671.4	1.238
Pre	Harris	TX	2.663	0.188	5.601	44.036	7.040	1	15	1820.6	5.279
Pre	Tangipahoa	LA	0.070	0.286	6.884	23.059	3.990	0	11	1261.2	0.778
Pre	Tarrant	TX	1.184	0.134	5.153	37.988	6.984	1	9	338.0	7.612
Katrina	Dallas	TX	1.676	0.218	5.653	49.863	8.680	1	10	9971.0	7.166
Katrina	E. Baton Rouge	LA	0.308	0.424	6.935	34.642	6.080	1	10	14291.0	1.238
Katrina	Harris	TX	2.827	0.188	5.687	49.248	7.330	1	15	38033.0	5.279
Katrina	Tangipahoa	LA	0.076	0.290	9.548	25.766	5.160	0	11	4758.0	0.778
Katrina	Tarrant	TX	1.280	0.140	5.145	41.070	7.320	1	9	5575.0	7.612
Post	Dallas	TX	1.808	0.226	6.359	54.800	8.402	1	10	670.0	7.166
Post	E. Baton Rouge	LA	0.318	0.453	5.392	41.435	7.614	1	10	2267.4	1.238
Post	Harris	TX	3.053	0.195	5.962	56.715	8.242	1	15	2700.6	5.279
Post	Tangipahoa	LA	0.084	0.301	6.548	30.813	6.014	0	11	1771.4	0.778
Post	Tarrant	TX	1.405	0.149	5.913	45.173	8.060	1	9	497.0	7.612

Note: Values for New Orleans, LA represent a population-weighted average of the affected counties. Pre, Katrina, and Post correspond to values from 2000-2004, 2005, and 2006-2010, respectively. Population is in millions, average pay is in thousands of dollars per year, average rent is in hundreds of dollars per month, and distance is in hundreds of kilometers. Migrants is the number of exemptions that move from the affected counties to a destination county.

Results

In Table 5, we present the results of a series of regressions related to the flow of migrants from the New Orleans area. In each column, we present a particular transformation of the flow of migrants from New Orleans to each destination county. Columns 1 and 2 correspond to the count of migrants and the inverse hyperbolic sine of migrant count, Column 3 relates to marginal effects of a logistic regression for whether or not a county had more than 10 migrants from any of the affected counties, and Column 4 is each county's share of all migrants leaving the New Orleans area.

In general, the results reflect relatively standard migration preferences. Counties that are large, or close to the New Orleans area are more likely to receive migrants than less populous counties or those that are far from southern Louisiana.⁵ Similarly, counties with lower unemployment and higher wages are more likely to receive migrants than counties with less robust economies, although we find no statistically significant effect of a destination county's median rent on migration decisions. There is also more migration toward counties that have historically incurred a large number of disasters than to those counties that have experienced a relatively small number of disasters. These effects are each true across each of the specifications.

When focusing on the intensive margin in 2005 (Columns 1 and 2), we primarily find an increased penalty on counties that are distant from New Orleans. While each additional hundred kilometers of distance resulted in a 2.2% decrease in the number of migrants to a county in the baseline, in 2005 the same marginal change in distance resulted in a 5.6% drop in migrants. Note that the distance variable could reflect actual preferences over proximity, or instead could reflect that financial moving costs tend to increase in travel distance. In the inverse hyperbolic sine specification, we find impacts on the economic pull factors that are statistically distinct from their non-interacted counterparts. The interpretation of the changes in these economic variables are mixed. The positive coefficients on the unemployment rate and on median rent each indicate a reduction in the importance of economic considerations, although the positive impact on average pay suggests the opposite. There is also more migration toward larger counties relative to other years; a county with an additional million residents would receive 166% more migrants than a county with fewer residents in most years but in 2005 the differential would be closer to 258%. We also find that there was more migration to predominately black counties in 2005 than in other years. While we can not identify the race of a particular migrant, pre-Katrina New Orleans had a relatively large black population and this effect is consistent with black migrants from Katrina moving to destinations with familial connections. Importantly, there was an overall increase in migration flow toward counties that were more exposed to disasters in 2005. While a marginal increase in the number of disasters between 1964 and 1999 was associated with around a 2% increase in migration flows in most years, in 2005 it was associated with nearly a 5% increase in migration flows. This suggests that the general increase in outflow migration from a dangerous area may in fact increase total population that is exposed to disaster risks. We find similar effects on the extensive margin (Column 3) in 2005. There is mixed evidence of a differential impact from economic considerations. While counties with high

⁵The results do not appreciably change if a destination county's population is replaced by its population density.

Table 5 Effect of destination characteristics on new orleans outflow migration

	<i>Dependent variable:</i>			
	Flow (1)	IHS (2)	Logit (3)	Share (4)
Population (Millions)	77.569** (32.508)	1.657*** (0.269)	0.022*** (0.007)	0.346** (0.143)
Distance (Hundreds of Kilometers)	-1.258*** (0.341)	-0.022*** (0.003)	-0.001*** (<0.001)	-0.006*** (0.002)
Percentage Black	14.214 (13.701)	0.686*** (0.152)	0.012* (0.007)	0.062 (0.062)
Unemployment Rate	-1.166*** (0.402)	-0.025*** (0.004)	-0.001** (<0.001)	-0.005*** (0.002)
Average Pay	0.706*** (0.237)	0.021*** (0.004)	0.0003*** (0.0001)	0.003*** (0.001)
Median Rent	1.174* (0.637)	0.063*** (0.013)	0.001*** (<0.001)	0.006** (0.003)
Number of Disasters	1.346*** (0.462)	0.024*** (0.006)	0.001** (<0.001)	0.006*** (0.002)
Non Metro	7.244 (4.822)	0.041 (0.050)	-0.004 (0.002)	0.033 (0.022)
Year 2005	872.729* (509.745)	2.058*** (0.263)	0.967*** (0.065)	0.094 (0.157)
Population X 2005	1,078.154 (807.630)	0.929* (0.532)	0.047* (0.024)	0.288 (0.320)
Distance X 2005	-7.357*** (2.152)	-0.034*** (0.004)	-0.0002 (0.0003)	0.001 (0.001)
Black X 2005	51.944 (106.372)	1.827*** (0.233)	-0.001 (0.003)	-0.026 (0.031)
Unemployment Rate X 2005	9.215** (3.770)	0.051*** (0.015)	0.001** (0.001)	0.010*** (0.003)

Table 5 (continued)

	<i>Dependent variable:</i>			
	Flow (1)	IHS (2)	Logit (3)	Share (4)
Average Pay X 2005	2.924 (3.489)	0.016** (0.007)	-0.0002* (0.0001)	-0.001 (0.002)
Median Rent X 2005	-35.394 (37.263)	0.143*** (0.041)	0.001 (<0.001)	-0.025 (0.021)
Number of Disasters X 2005	2.548 (2.783)	0.022*** (0.008)	-0.0003 (0.0002)	-0.004*** (0.001)
Non Metro X 2005	4.336 (28.825)	-0.505*** (0.062)	-0.0003 (0.001)	-0.027*** (0.008)
Constant	97.897*** (32.867)	2.412*** (0.268)		0.438*** (0.145)
Observations	32,956	32,956	32,956	32,956
R ²	0.114	0.346		0.109
Adjusted R ²	0.113	0.346		0.108
Log Likelihood			-2,943.082	
Akaike Inf. Crit.			5,922.164	

Note: *p<0.1; **p<0.05; ***p<0.01

unemployment rates and high rents were relatively more likely to receive migrants in 2005 – indicating that economics became less important immediately following the disaster – counties with higher wages were also more likely to receive migrants in 2005 which suggests the opposite.

In most years, the share of migrants (Column 4) tends to reflect the results from the intensive and extensive margin regressions. Large counties close to New Orleans that have strong economies receive a greater share of migrants than distant, small counties with weak economies. When we focus on the interaction terms, however, relatively few variables are statistically significant. As with the other three regressions, and consistent with the idea that economic conditions matter less in the face of a natural disaster, the unemployment rate mattered less in 2005 than it did in other years. While a one percentage point increase in the unemployment rate reduced the share of New Orleans migrants to a county by about 0.2 percentage points, in 2005 counties with higher unemployment rates actually received a greater share of migrants from New Orleans than those with low unemployment rates. More importantly, the effect of previous disaster exposure on the share of migrants from the New Orleans area declined in 2005. This suggests that migrants did have some consideration for the overall riskiness of a destination, and were more drawn to safer destinations than they

Table 6 Effect of destination characteristics on new orleans outflow migration - excluding houston

	<i>Dependent variable:</i>			
	Flow (1)	IHS (2)	Logit (3)	Share (4)
Population (Millions)	46.519*** (6.627)	1.619*** (0.267)	0.021*** (0.007)	0.208*** (0.028)
Distance (Hundreds of Kilometers)	-0.963*** (0.182)	-0.022*** (0.003)	-0.001*** (<0.001)	-0.004*** (0.001)
Percentage Black	22.055** (11.221)	0.696*** (0.152)	0.012* (0.001)	0.097* (0.051)
Unemployment Rate	-0.892*** (0.287)	-0.025*** (0.004)	-0.001** (0.001)	-0.004*** (0.001)
Average Pay	0.534*** (0.156)	0.021*** (0.004)	0.0002*** (0.0001)	0.002*** (0.001)
Median Rent	1.193** (0.499)	0.063*** (0.013)	0.007*** (0.0002)	0.006*** (0.002)
Number of Disasters	1.285*** (0.454)	0.024*** (0.006)	0.001** (<0.001)	0.006*** (0.002)
Non Metro	3.187 (2.312)	0.036 (0.049)	-0.004 (0.002)	0.015 (0.011)
Year 2005	403.572*** (118.238)	2.084*** (0.284)	0.967*** (0.0067)	-0.042 (0.040)
Population X 2005	344.287** (160.999)	0.948* (0.568)	0.047* (0.024)	0.006 (0.068)
Distance X 2005	-5.539*** (1.164)	-0.035*** (0.004)	-0.0002 (0.0003)	0.001** (0.0004)
Black X 2005	142.004** (59.802)	1.819*** (0.233)	-0.001 (0.003)	-0.007 (0.026)
Unemployment Rate X 2005	7.441** (3.140)	0.051*** (0.015)	0.001** (0.001)	0.007*** (0.002)

Table 6 (continued)

	<i>Dependent variable:</i>			
	Flow (1)	IHS (2)	Logit (3)	Share (4)
Average Pay X 2005	2.796** (1.362)	0.016** (0.007)	-0.0002* (0.0001)	-0.001 (0.001)
Median Rent X 2005	1.347 (5.727)	0.144*** (0.042)	0.001 (0.001)	-0.005 (0.003)
Number of Disasters X 2005	2.329 (1.970)	0.023*** (0.008)	-0.0002 (0.0002)	-0.004*** (0.001)
Non Metro X 2005	-17.807 (12.820)	-0.500*** (0.062)	-0.0002 (0.001)	-0.023*** (0.006)
Constant	66.708*** (8.984)	2.374*** (0.268)		0.300*** (0.039)
Observations	32,945	32,945	32,945	32,945
R ²	0.097	0.336		0.079
Adjusted R ²	0.096	0.336		0.079
Log Likelihood			-2,943.082	
Akaike Inf. Crit.			5,922.164	

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

would be in other years. We reconcile this result with the intensive and extensive results by noting that this effect is about changes to the migration distribution. While the distribution of migrants shifted toward safer areas in 2005, most migrants from New Orleans tend to move to other dangerous areas and the shift in the distribution was not enough to outweigh the overall increase in migration flows. As a result, there were more people moving to dangerous areas than in other years even though any given migrant was more likely to move to a safe area.

A large number of residents of New Orleans were evacuated to Houston (Harris County), Texas by FEMA. While many of these people eventually settled permanently in Houston, these movements may not signal a particular preference for Houston, but rather path-dependence in relocation. Because Houston is relatively populous and had a relatively strong economy in 2005, it could be biasing our results. One could imagine, for example, that the increased migration toward more populous counties in 2005 is actually driven by FEMA relocations to Harris County, rather than any particular preference for populous destinations. In Table 6, we present our regression results again, while omitting Harris County, Texas, from the set of possible destinations. The results are qualitatively similar to the full sample.

For the baseline coefficients, we see small reductions in magnitude for population, distance, and average pay. Similarly, we generally see small reductions in magnitude for the 2005 interaction terms. Our general results, that greater numbers of migrants moved to nearby and populous counties in 2005 than in most years but that the only notable change to the distribution of migrants is in the disaster exposure variable, is robust to removing Houston, the primary destination of direct FEMA evacuees.

While Hurricane Katrina resulted in substantial increases in outflow migration, much of it to areas that were relatively likely to be affected by future hurricanes, the overall composition of migration remained relatively unchanged. Because people tend to migrate to close areas rather than distant ones, post-disaster migration is unlikely to be a panacea for reducing natural hazards risks. Still, disaster-related migration may still result in some social benefits. People tend to migrate toward urban population centers rather than rural communities, so disasters may serve to accelerate the shift of populations toward cities, in which they may benefit from agglomeration effects and experience higher productivity.

Conclusion

There is a growing amount of discussion about the ability to minimize damages from climate change via adaptation. One dimension of such adaptation is the potential for people to move away from areas that become more exposed to natural disasters in favor of areas that are safer. While it is well-established that people move away from disaster-afflicted regions, it is unclear what this migration does to future disaster risks. This paper has sought to inform how disasters influence the destination of migrants by focusing on the characteristics of the destinations of post-Katrina migrants from the New Orleans area. An understanding of the factors driving post-disaster migration is important both in planning for shifts in population and in assessing future damages from natural disasters.

In most years, migration away from the New Orleans area corresponds with traditional gravity model results. Migrants prefer close destinations to distant ones, and tend toward large, economically strong counties rather than rural ones with fewer economic prospects. This is true across a range of specifications describing outflow migration.

In the immediate evacuation and aftermath of the hurricane there was substantial migration away from the New Orleans area. Historical disaster frequency became more important to migrants in 2005 than in other years, and counties that were relatively safe received a greater proportion of New Orleans-area migrants than they did in most other years. Still, because of the magnitude of migration outflow from New Orleans following Hurricane Katrina, there was still an overall increase in migration toward regions that were highly exposed to natural disasters. While some migrants may be more likely to consider disaster risk in their migration decisions following a major disaster, it is not guaranteed that post-disaster migration will reduce overall disaster exposure.

As natural disasters grow more frequent and more costly, disaster-related migration will increase. While migration away from high-risk regions could reduce future disaster losses, the change in migration preferences is small relative to the overall increase in the number of migrants. Government policy could be used to incentivize migration toward safer destinations that are further from the affected area, but, in the absence of such policy interventions, migration is unlikely to lower the costs of future disasters.

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