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Hurricane strikes and local migration in US coastal counties

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HIGHLIGHTS

- We model the impact of hurricanes on inward and outward migration rates and their incomes in US coastal counties.
- We show that there is no effect on inward migration.
- There is a sizeable impact on outward migration and these migrants tend to be richer than those that leave during non-hurricane times.

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ABSTRACT

We examine the effects of hurricane shocks on key migration variables in US coastal counties. Results show that hurricane strikes increase the outward migration rate and that these migrants were somewhat wealthier, but that there was no impact on inward migration.

1. Introduction

Hurricanes are largely unpredictable events that can cause potentially large disruptions to local economies.[1] One facet through which the effects may manifest themselves is through outward migration, as individuals who experience job loss and destruction of personal property seek their luck elsewhere. Indeed evidence found by Strobl (2011) for the US suggests that this effect has not been negligible in recent times. However, at the same time the demand surge due to reconstruction and repair needs will cause some sectors to flourish and hence make the area an attractive place for workers from outside to locate in. For example, Strobl and Walsh (2009) showed that an average hurricane strike caused employment in construction in affected US counties to increase by 25% over the same period. Thus the overall effect on net migration is not a priori clear. As a matter of fact, in a study of counties in the 1920s and 1930s Boustan et al. (2012) find that there was no net effect of hurricane events on net migration, while results from Strobl (2011) suggest that inward migration will be slightly larger than outward migration.

One problem with the existing studies is that these all only measure the direct (partial) effects of hurricanes, i.e., holding other factors constant. In reality, however, inward and outward migration flows are likely to affect each other, as well as their incomes, so that the impact of a hurricane strike is likely to have indirect effects as well. In the current study we thus, by using a VAR analysis, allow for the impact of the storms on the whole system of migration, where the effect may take place through directly encouraging outward and/or discouraging inward migration flows and their composition, as well as allowing for feedback effects via these factors.

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1 For instance, Strobl (2011) found that an average hurricane strike causes county growth rates to fall by 0.45 percentage points.

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Table 1
Unit root results.

Variables	W_{stat}		t^*		Z_{tbar}	
	Test-stat	*p-values*	*Test-stat*	*p-values*	*Test-stat*	*p-values*
Irate	−59.277	0.000	−33.4687	0.000	−6.396	0.000
Orate	−67.098	0.000	−53.369	0.000	−4.539	0.000
Iwage	−22.980	0.000	−5.768	0.000	−12.236	0.000
Owage	−22.330	0.000	−4.010	0.000	−12.162	0.000

2. Hurricane destruction index and data

In order to identify potentially destructive hurricane events we employ a measure that takes account of the spatial structure and movement of a hurricane, and hence of actual local wind speeds experienced, and the potentially affected population. We then translate these factors into a proxy of local destruction. More precisely, we follow Strobl (2011) and identify potential hurricane destruction as:

$$HURR_{i,t} = \sum_{j=1}^{m} \overline{V}_{i,j,t}^{3} w_{i,j,t-1} \tag{1}$$

where V is the maximum sustained wind speed accumulated over time intervals t. Subscripts i and j refer to county and census tract, respectively. One should note that destruction is assumed to depend on the cubic power of wind speed, as suggested by Emanuel (2005). $w's$ are weights assigned according to characteristics of the affected census track intended to capture geographical differences within countries in terms of the 'potential' damage if a hurricane were to strike. For these weights we use the time varying share of county level population of each individual census tract at *t-1*, where the underlying argument is that, even if severely damaged by hurricane winds, sparsely populated areas are unlikely to play a significant role in the overall destruction of physical structures due to hurricanes in a county in any period t. We interpolate population shares between census years to obtain annual figures. In order to estimate wind speeds experienced in census tracts within counties we avail of the wind speed estimates that form the basis of the well-known HAZUS software, a widely used program developed by the FEMA to enable hurricane damage loss estimation in the US. The wind speeds in HAZUS are generated by using information from the full historical tracks of hurricanes as given in HURDAT, beginning with their initiation over the ocean and ending with their final dissipation, in conjunction with the wind field model by Vickery et al. (2000). Storms included are those of Category 3, 4 or 5 storms (at the time of US landfall) on the Saffir–Simpson scale. One should note that using an ex-ante measure of destruction like (4) circumvents obvious potential endogeneity problems of using ex-post damage or disaster declaration data to define significant events.

In order to construct inward and outward migration rates, as well as the average income of these, we use the Internal Revenue Service (IRS) County-to-County Migration Data, which are constructed from IRS tax returns and available from 1991 onwards. More specifically, inward (outward) migration flows are constructed based on year-to-year changes in the addresses entered on income tax returns filed by individual taxpayers and the number of individuals listed on their returns as exemptions. We use these data to construct annual inflow and outflow migration rates (relative to the previous year's number of returns and exemptions) for each county, as well as the average income of the inward and outward migrants.

Finally, given that hurricanes lose wind speed and are declassified to regular storms fairly quickly once they make landfall, we limit our analysis to the coastal counties on the Eastern coast. Overall this provides us with a balanced panel of information for 409 counties over the period 1991–2005.[2]

3. Econometric methodology

To analyze the interplay between hurricane strikes and migration we adopt a panel VAR methodology. Our reduced form VAR takes the following specification:

$$y_{i,t} = \sum_{k=1}^{p} \varpi_j y_{i,t-k} + \sum_{k=0}^{s} \xi_j x_{i,t-k} + \sigma_{i,t} \tag{2}$$

where y and x represent the vectors of endogenous and exogenous variables, respectively; t stands for the time; σ represents the error term of the system, which is assumed to be independent within and across equation; i is the county index. The vector $y_{i,t}$ (which includes 4×1 endogenous variables), and the vector $x_{i,t}$ (which includes the 1×1 exogenous variable) can be written, respectively, as:

$$y_{i,t} = \begin{bmatrix} Irate_{i,t} \\ Orate_{i,t} \\ Iwage_{i,t} \\ Owage_{i,t} \end{bmatrix}; \qquad x_{i,t} = \left[Hurricane_{i,t}\right] \tag{3}$$

where *Irate* stands for the inward migration rate, *Orate* is the outward migration rate, *Iwage* stands for the inward migrants' average income, and *Owage* is the outward migrants' average income. *Hurricane* is our hurricane destruction index.

Before implementing our panel VAR methodology we must first ensure that our endogenous variables are stationary. For this purpose we check the time series properties of the variables using three unit root techniques. More specifically, we employ the Levin et al. (2002), the Im et al. (2003), and the Pesaran (2007) panel unit root tests denoted as, respectively, W_{stat}, t^*, and Z_{tbar}. While the first two tests assume cross-sectional independence, the last allows for cross-sectional dependence. The results, which are summarized in Table 1, suggest that the null hypothesis of a unit root can be rejected; consequently the variables can be used in the level form in the panel VAR.

In addition to the time series property of the data it is also important to determine the lag structure of the VAR before proceeding to the estimation of the VAR. For this purpose we set a maximum of lag of 2 and use the AIC and SBC to ascertain the lag order of the VAR. Both information criteria suggest a VAR of order 2.

Estimation results from our VAR model and the ensuing impulse response functions are portrayed, respectively, by Table 2 and Fig. 1. The results show that the estimates of the response of *Orate* and *Owage* are positive and statistically significant up to a year following the initial hurricane strike. These effects become

[2] In terms of identifying coastal counties in this area we rely on the list generated by the Strategic Environmental Assessments Division of the National Oceanic and Atmospheric Administration (NOAA). Accordingly, coastal counties are defined as those which have at least 15 per cent of their land in the coastal watershed or that comprise at least 15 per cent of a coastal cataloging unit.