Reply to Bakkensen and Larson: Population may matter but does not alter conclusions

Madhu Viswanathan
Loyola Marymount University, madhubalan.viswanathan@lmu.edu

LETTER

LETTER

Reply to Bakkensen and Larson: Population may matter but does not alter conclusions

We report that for highly damaging hurricanes, not for less damaging hurricanes, name femininity predicts more fatalities (1). We suggest this may be because, for damaging storms, factors such as storm names that motivate protective action are more predictive of survival. Bakkensen and Larson (2) assert that our modeling suffers from endogeneity and lack of adjustment for population. The authors report reversed or no effect of hurricane names in models with completely different inputs. We show below that their approach and analyses are flawed, yielding incorrect conclusions.

First, Bakkensen and Larson (2) provide no evidence for endogeneity bias in our models. Contrary to their assertion, a standard assessment for endogeneity as detailed in Hilbe (3) and Cameron and Trivedi (4) shows no bias at the level requiring adjustments ($P > 0.10$). (To test whether normalized damage is endogenous to fatalities, we built a simple original model in which fatality was regressed on normalized damage and gender index. Next, we regressed normalized damage on gender index and minimum pressure and obtained residuals. Finally, residuals were added as an additional regressor in the original model as well as in the count model. The added residuals were not statistically different from zero.) Dropping normalized damage as an "endogenous variable" is therefore unwarranted.

Nevertheless, Bakkensen and Larson drop the damage predictor, the focal indicator of actual impact on population centers (1), such that their modeling does not address our hypothesis. Instead, the authors add population main effects and interactions without a conceptual rationale (2). A close look at these analyses reveals multiple flaws: Although they report no dispersion or model-fit statistics, we reproduced their modeling (model 2) using annual US population data and found it is not viable because of serious overdispersion and poor model-fit (Pearson's χ^2/df = 1.92; Akaike information criterion/Bayesian information criterion = 684.85/699.98). In contrast, our original model (1) showed minimal overdispersion and good model-fit (Pearson's χ^2/df = 1.09; Akaike information criterion/Bayesian information criterion = 656.09/671.22). Ironically, Bakkensen and Larson's (2) overdispersion and model-fit problems raise concerns about an omitted variable (damage) and possible endogeneity.*

We do agree that, as population at risk increases, hurricane fatalities should increase *ceteris paribus*. However, adjusting for population density of just five coastal counties (models 3–6) is problematic: 150 counties are in the average hurricane's path and inland fatalities account for an increasing fraction of deaths, up to 80% (5). We also cannot abide Bakkensen and Larson's (2) use of population indicators both as predictors and adjustments to outcomes (model 5). Finally, normalizing count data to use ordinary least-squares regressions (models 5–6) is inappropriate (3, 4), as is their log-transformation of normalized deaths, which caused the 10 observations with zero values to simply disappear.

Instead, to address population at risk, fatality counts can be adjusted for contemporaneous US population in our original model (1). [For example, Hurricane Edna's 20 deaths in 1954 (US population: 163,000,000) would be adjusted to 39 deaths (US population in 2012: 314,000,000); population data source: US Census Bureau.] Doing this yields virtually identical results, replicating the focal gender index × normalized damage interaction ($P = 0.002$). As previously reported (1), adding elapsed years to our original model as an adjustor also yields the same results.

In short, controlling for population does not affect our conclusions. We do not claim that it is unimportant. However, the effect of a growing population at risk over time may be offset by other factors, such as improved protective measures over time.

In conclusion, we agree that further research on the impact of gendered hurricane naming is warranted (2). However, appropriate model specifications and inputs matter. Analyses demonstrate our modeling does not suffer from endogeneity bias, is appropriate to the probability distribution of our count data, and provides a well-fitted model. Population adjustment does not alter its conclusions.

***Kiju Jung*[a,1], *Sharon Shavitt*[b,c,1], *Madhu Viswanathan*[b], and *Joseph M. Hilbe*[d]**

[a]*Economics and Business Building, The University of Sydney Business School, Sydney, NSW 2006, Australia;* [b]*Department of Business Administration, and* [c]*Department of Psychology, Institute of Communications Research, and Survey Research Laboratory, University of Illinois at Urbana–Champaign, Champaign, IL 61820; and* [d]*Department of Statistics, T. Denny Sanford School of Social and Family Dynamics, Arizona State University, Tempe, AZ 85287-3701*

1 Jung K, Shavitt S, Viswanathan M, Hilbe JM (2014) Female hurricanes are deadlier than male hurricanes. *Proc Natl Acad Sci USA* 111(24):8782–8787.

2 Bakkensen LA, Larson W (2014) Population matters when modeling hurricane fatalities. *Proc Natl Acad Sci USA* 111:E5331–E5332.

3 Hilbe JM (2011) *Negative Binomial Regression* (Cambridge Univ Press, Cambridge, UK), 2nd Ed.

4 Cameron AC, Trivedi PK (2010) *Microeconometrics Using Stata* (STATA, College Station, TX), Revised Ed.

5 Czajkowski J, Simmons K, Sutter D (2011) An analysis of coastal and inland fatalities in landfalling US hurricanes. *Nat Hazards* 59(3): 1513–1531.

Author contributions: K.J., S.S., M.V., and J.M.H. analyzed data and wrote the paper.

The authors declare no conflict of interest.

[1]To whom correspondence may be addressed. Email: k.jung@econ.sydney.edu.au or shavitt@illinois.edu.

*Bakkensen and Larson also misinterpreted their gender index × US population interaction to mean that name femininity is protective. Examining their model 2 coefficients reveals a different pattern: When population is low (−1 SD in population), a feminine-named hurricane (+1 SD in gender index) is estimated to cause many more fatalities (29 fatalities) than a masculine-named hurricane (−1 SD: 6 fatalities). When population is high, this difference is not found (+1 SD in gender index: 12 fatalities vs. −1 SD: 15 fatalities).