

## Hurricane Effects on Small Businesses: A Case Study of Hurricane Harvey

○Daan LIANG, Kazuyoshi NISHIJIMA, Masamitsu ONISHI

Economic resilience is defined as an area's ability to prevent, withstand, and quickly recover from major disruptions to its economic base. Instead of having repeated damages and needs for outside assistance, resilient communities proactively protect themselves against hazards, build self-sufficiency, and become more sustainable over the long term. Within these communities, small businesses are an important driver of economic growth and employment. They tend to behave differently from their larger counterparts and can adapt quickly to a society's changing needs in a competitive business environment. However, small businesses are extremely vulnerable to natural disasters: about 40-60 percent of them never reopen their doors after a disaster.

To gain an insight into the vulnerability and resilience of small businesses, this study models their recovery trajectories after major hurricanes as a Poisson process in which the recovery states of individual firms are randomly located in the time space. We collected firm-level data through an online survey following Hurricane Harvey, a Category 4 hurricane that made landfall on August 25, 2017, between Port Aransas and Port O'Connor with sustained winds over 130 mph. The storm caused catastrophic flooding and 68 direct deaths. The economic loss was estimated at \$120 billion as it displaced more than 30,000 people, prompted more than 17,000 rescues, and shut down ports, trade, tourism, agricultural production, and general businesses across most of the Texas coast. The effects on oil and gas production were felt across the

nation. At the same time, the cost of Harvey's destruction was partially offset by an increase in business activities related to reconstruction and restoration efforts, combined with an influx of funding from federal aid and insurance payments.

The questions on the survey covered five broad categories: general business characteristics; finance impact; operation impact; built environment impact; and mitigation actions. The survey took place between October 15 and November 13, 2020 and a total 360 valid responses were recorded.

We first analyzed the covariance of a firm's recovery time and its industry group classification, attributing to the fact that different industries are sensitive to different sets of community-level factors such as repopulation, infrastructure restoration, market condition, and competition. Then the effect of a firm's own action towards preparedness was examined.

The result shows a marked variation in recovery time between industry groups. On average, it takes a firm about 10 months to return to pre-storm operation level. However, the duration decreases to 9 months for firms in trade, transportation, and warehousing; or increases to 11 months for ones in hospitality, food and entertainment services. The pace of recovery for firms in construction (10.5 months) is long than the average, seemingly contractionary to demand surge often-cited after a disaster.

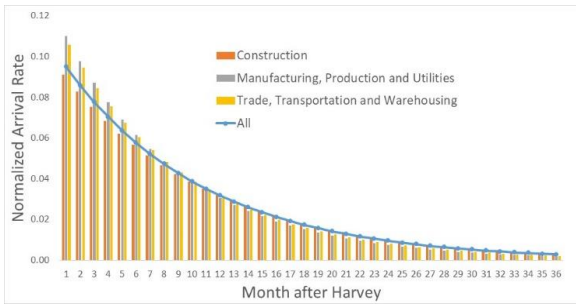


Figure 1 Monthly arrival rates of recovery for small businesses in construction, manufacturing, and trade groups. The exponential distribution is used in calculation.

We then simulated the entire recovery process for the study area and compared it to the survey result. Over the first 18-month period the model under-predicts the number of firms recovered while capturing the overall trend. Other probability functions (e.g., lognormal) may lead to a better outcome

What is illuminating is the effect of investment in resilience. In our model, 82% of firms who make such investment before the storm would have fully recovered after 12 months, compared to just 56% of ones who don't.



Figure 2 Modelled recovery trajectories for small businesses who make investment in resilience and who don't. The curves represent mean values derived from 100 stochastic simulations

In summary, the firm-level, time-dependent modeling approach we adopted is consistent with an increasing emphasis on access to timely (or even real-time), high-spatial resolution information on consumer spending and business performance to inform economic policies. The government surveys on

employment and commodity prices are often too coarse to study localized or short-lived economic shocks. As an alternative approach to fill these information gaps, one team used anonymized transactions data from a large electronic payments technology company to create daily estimates of retail spending at detailed geographies. When applied to Hurricanes Harvey and Irma in 2017, they found that spending at building materials stores ramped up before the hurricane and rebounded afterwards, such that the net effect for this category is positive. Spending at grocery stores also ramped up before the hurricane but did not rebound afterwards so that the net effect was negative. Another study examined the credit reports of 8,219 businesses and a detailed survey of 273 businesses in the area affected by Hurricane Harvey. They found that Harvey increased credit delinquencies. Firms whose managers report being worried about climate change were likely to increase insurance coverage. Considering that the National Flood Insurance Program do not offer business interruption coverage, firms would need to increase their cash reserves or credit lines.

This study has several practical implications. First, it provides baselines of post-hurricane recovery for small businesses. Before a hurricane hits, a firm could anticipate the probable length of recovery required and prepare a business continuity plan. In its aftermath, they are able to benchmark their performance against that of their peers. A quicker recovery is likely to ensure a competitive advantage and a larger market share. After seeing a clear and tangible benefit from making resilience investment, they would be more motivated to act proactively. Since local government revenues are closely linked to taxes on business profits and payrolls, public policies towards incentivizing pre-storm mitigation and resilience building should be supported.