

Quantifying the Economic Impact of Natural Disasters

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January 18, 2019 | DSI #6

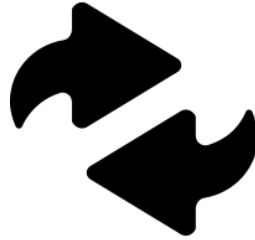
Problem Statement

Use public / private data sources to estimate the expected economic wage loss due to a disaster

Type of Economic Loss



**Infrastructure &
Personal
Property**



**Trade /
Commerce**



**Wage / Labor
Markets**

API Limitations

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Data Gathering

Natural Disasters

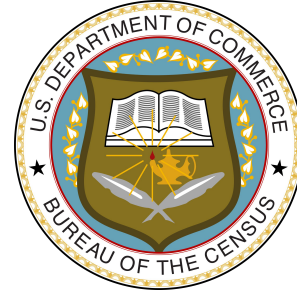


FEMA

Unemployment Insurance / Disaster Assistance



Wages and Employment



Initial Investigation Method

FEMA and Quarterly Indicator Dataset

- Time Series Investigation
 - Trends of indicator on quarterly basis, SARIMA and ARIMA
- Correlation Quarterly Indicators and FEMA Natural Disasters
 - Integration on state, county, and quarterly reports
 - Low correlation: Avg Corr less than 10%
- Examine Predictive Capabilities
 - Granular level view of top natural disaster states, TX, LA, CA, FL
 - State quarterly average earnings(y) to natural disaster type, (X)
 - Low predictive capabilities

Final Investigation Method

Reevaluation Considerations

- Quarterly data not granular enough
- Broad scope of natural disasters
- Indicators/Modeling of economic loss/wage loss

Adjustments

- US Labor Statistics for weekly unemployment and earnings claims
- Focus on known natural disaster for a specific county
- Model economic wage loss based on similar economic studies.



FEMA



What do Studies Show?

General Wage Economic Impacts

From Annual Review of Resource Economics:

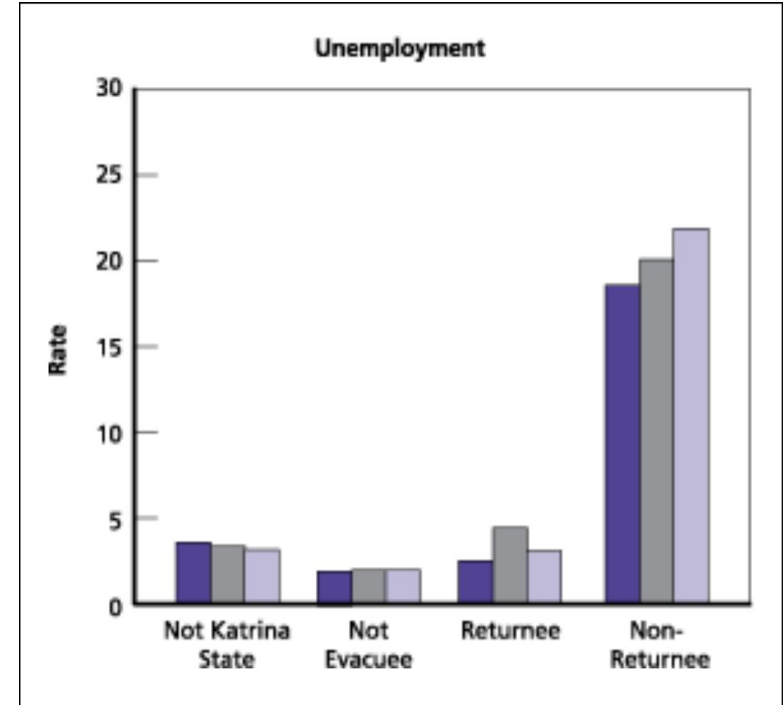
- **Lower Aggregate Employment but Higher Income Levels:** Average, aggregate local employment falls by 3.4% following a flood event as workers flee the area; Income levels, however, increase following a disaster¹
- **Decrease in Labor Supply & Increases in Labor Demand Boosts Income:** In Florida post-hurricane, income grew by 4.35% in directly affected areas as a result of the decrease in the labor supply and the simultaneous increase in post-hurricane labor demand, particularly in construction and building¹

1) The Economics of Natural Disasters; Derek Kellenberg and A. Mushfiq Mobarak

Hurricane Katrina

From RAND:

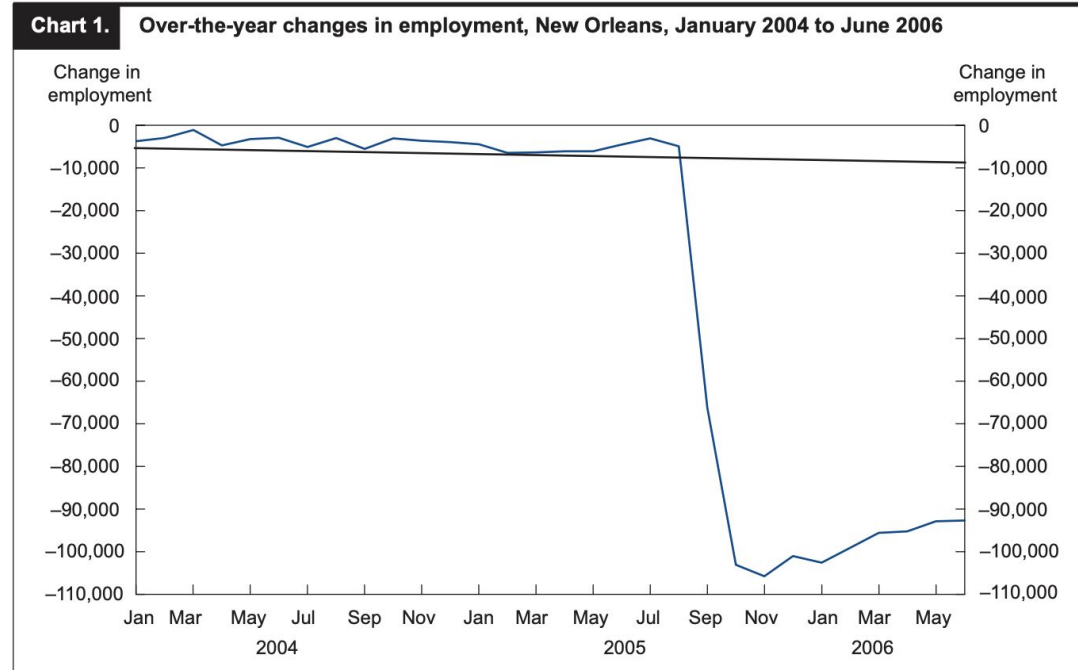
- “..relatively short-term negative outcomes followed by eventual recovery.”²
- For evacuees, ‘non-returnees...had employment rates one year later that were almost half those of non-evacuees and unemployment rates almost seven times as high.’²



Hurricane Katrina

From Bureau of Labor Statistics:

- **Job Loss Estimate:** During the first 10 months post-hurricane, they lost an over-the-year average of 92,000 jobs.³
- **Wage Loss Estimate:** Approximately \$2.9 billion, with 76% attributed to the private sector.³



Hurricane Katrina

From Bureau of Labor Statistics:

Methodology:

- Comparison of employment levels from one month to the previous year's month to account for seasonality.³
- Inferred employment trend lines for specific industries by doing linear regression on the previous three years of data to project into the future.³
- “The deviation from this trend line during the subsequent months indicates the impact of Katrina, not only in terms of job loss, but also on the rate of sector growth”³

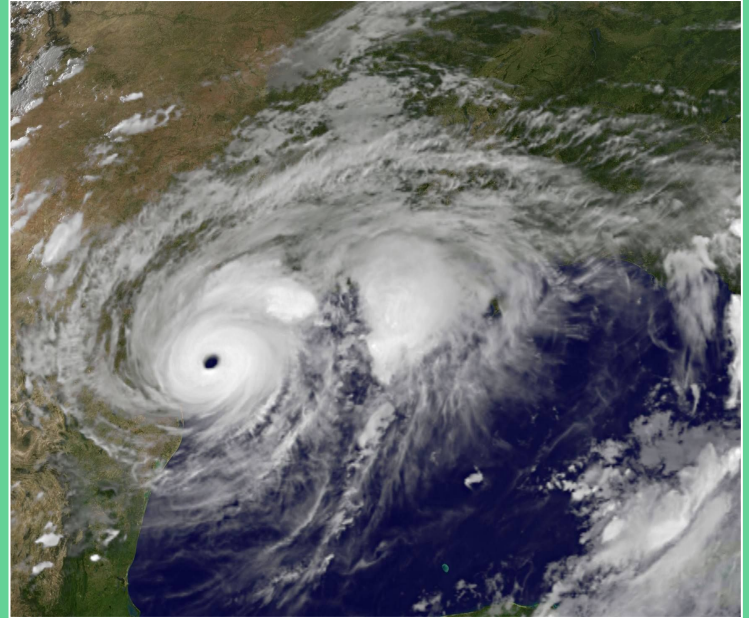
3) The Effects of Hurricane Katrina on the New Orleans Economy; Michael L. Dolfman, et al.

Case Study:

Hurricane Harvey

Houston, Texas

Aug - Sep 2017



Forecasting Methodology

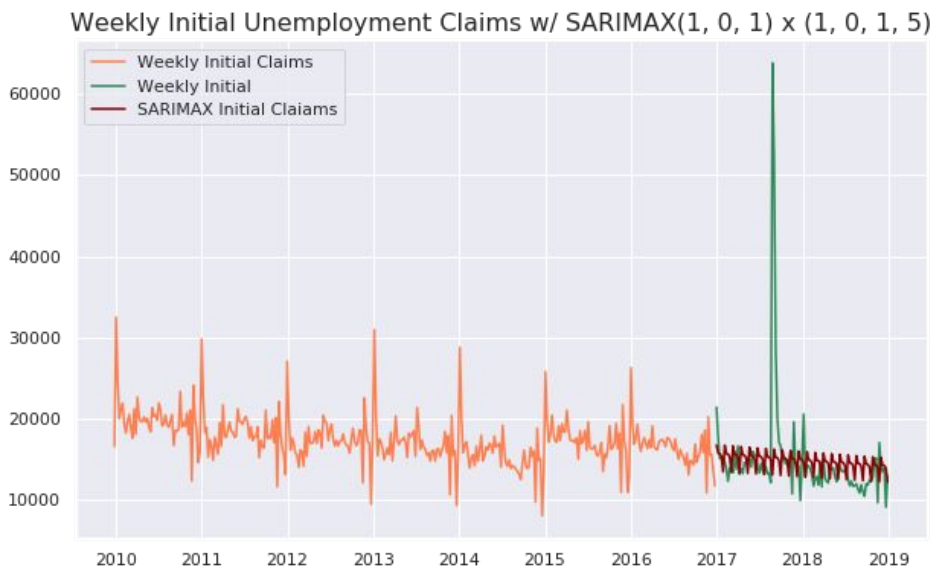
- 1 Isolate **key indicators (i.e., employment / unemployment)** in time periods leading and trailing significant natural disasters
- 2 Determine auto-regression hyperparameters for **Seasonal Autoregressive Integrated Moving Average (SARIMA)** time series forecast
- 3 **Forecast key indicators** during post-disaster; 1 year
- 4 Quantify **difference of forecasted versus actual**

Estimated Wage Loss = (Predicted - Actual Employment) x Avg. Weeks Unemployed x (Avg. Hourly Wage x Avg. Hours Worked / Week)

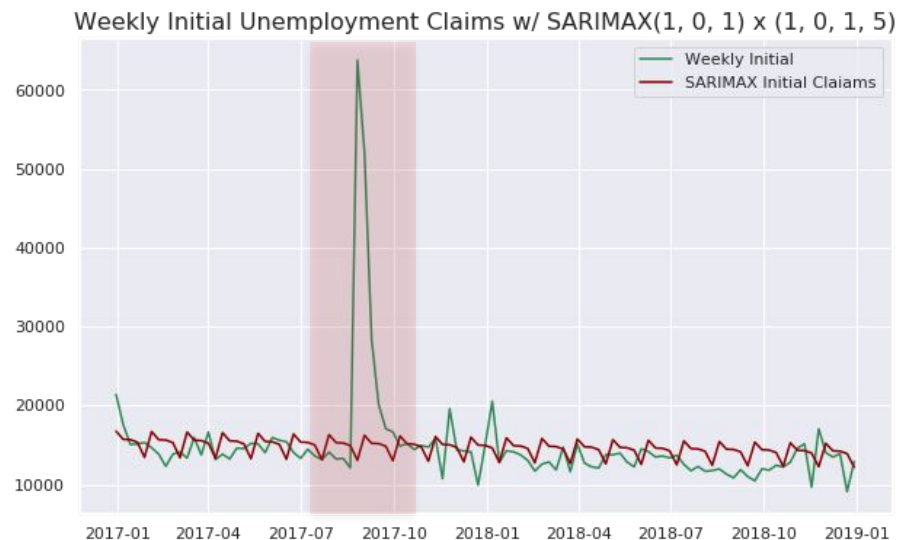
Estimated Benefits Provided = (Predicted - Actual Unemployment Claims) x Avg. Weekly Benefit x Avg. Weeks Unemployed

Hurricane Harvey - Houston Initial Unemployment

1990 - 2019



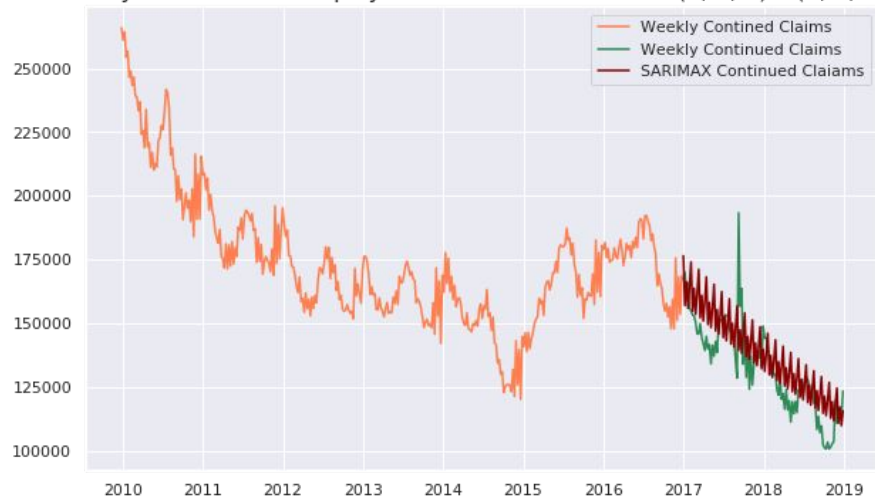
2017 - 2018



Hurricane Harvey - Houston Cont. Unemployment

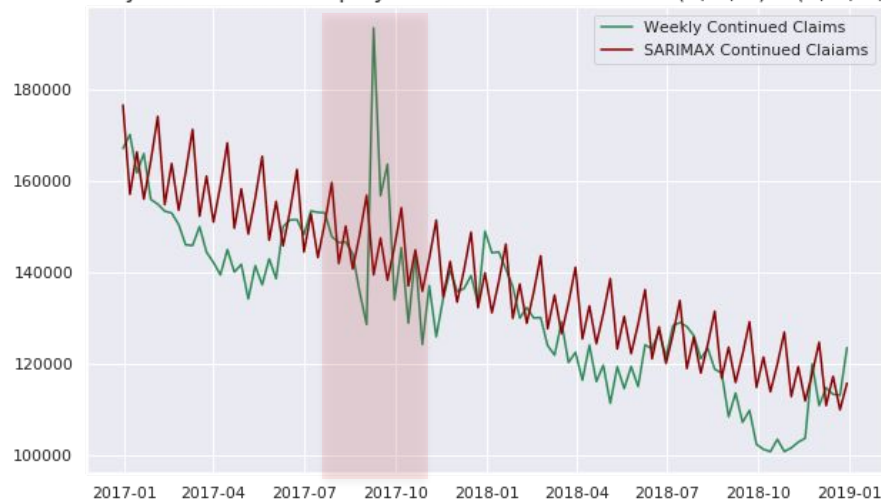
1990 - 2019

Weekly Continued Unemployment Claims w/ SARIMAX(1, 0, 1) x (1, 0, 1, 5)



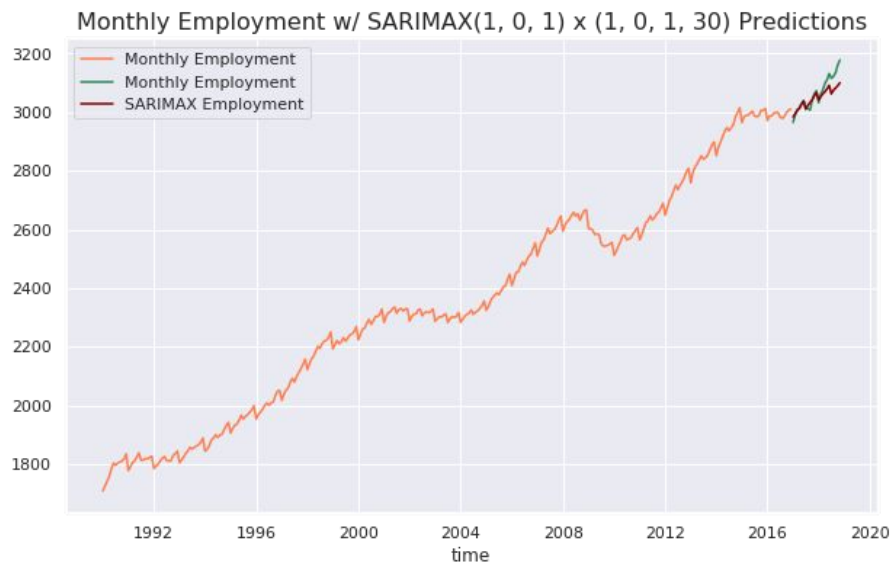
2017 - 2018

Weekly Continued Unemployment Claims w/ SARIMAX(1, 0, 1) x (1, 0, 1, 5)



Hurricane Harvey - Houston Employment

1990 - 2019



2017 - 2018

Monthly Employment w/ SARIMAX(1, 0, 1) x (1, 0, 1, 30)



Considerations

1. Disasters are becoming increasingly more severe and aggregate trends are becoming less predictable
2. Fluctuations in wage, employment, and unemployment post-disaster are not usually long-term in nature
3. Unless natural disaster is extreme, it is difficult to isolate unemployment impacts due to disasters vs. normal business cycle

Dashboard Demo

<https://public.tableau.com/profile/drew.hoppes#!/vizhome/HarveyViz/StoryofHurricaneHarvey>

Works Cited

1. Derek Kellenberg & A. Mushfiq Mobarak, 2011. "The Economics of Natural Disasters," Annual Review of Resource Economics, Annual Reviews, vol. 3(1), pages 297-312, October.
2. Zissimopoulos, J., & Karoly, L. A. (2010). Employment and self-employment in the wake of Hurricane Katrina. *Demography*, 47(2), 345-67.
3. Dolfman, Michael L., et al. The Effects of Hurricane Katrina on the New Orleans Economy. Bureau of Labor Statistics, www.bls.gov/opub/mlr/2007/06/art1full.pdf.