https://www.federalreserve.gov/econresdata/notes/feds-notes/2016/effect-of-hurricane-matthew-on-consumer-spending-20161202.html?mod=article_inline

December 2, 2016

The Effect of Hurricane Matthew on Consumer Spending

Aditya Aladangady, Shifrah Aron-Dine, Wendy Dunn, Laura Feiveson, Paul Lengermann, and Claudia Sahm [1]

Severe weather events, such as blizzards and hurricanes, can temporarily disrupt economic activity. The imprints of these events on aggregate statistics can make it challenging for macroeconomists to analyze and forecast economic conditions. As one illustration, the minutes from March FOMC meetings in six of the past seven years cited unseasonable temperatures or winter storms as influencing economic activity.

Weather events present an opportunity to observe how consumers adjust their spending in the face of unanticipated shocks. Thus far, however, there has been little analysis of the spending effects from weather events, partly due to a lack of data at both a sufficiently high frequency and a geographically detailed level. For example, official statistics, such as retail sales from the Census Bureau, are only estimated nationally at a monthly frequency. In this note, we take a step forward in this regard using a new dataset of transaction volumes to examine how consumers reacted to Hurricane Matthew, which struck the East Coast in October 2016.

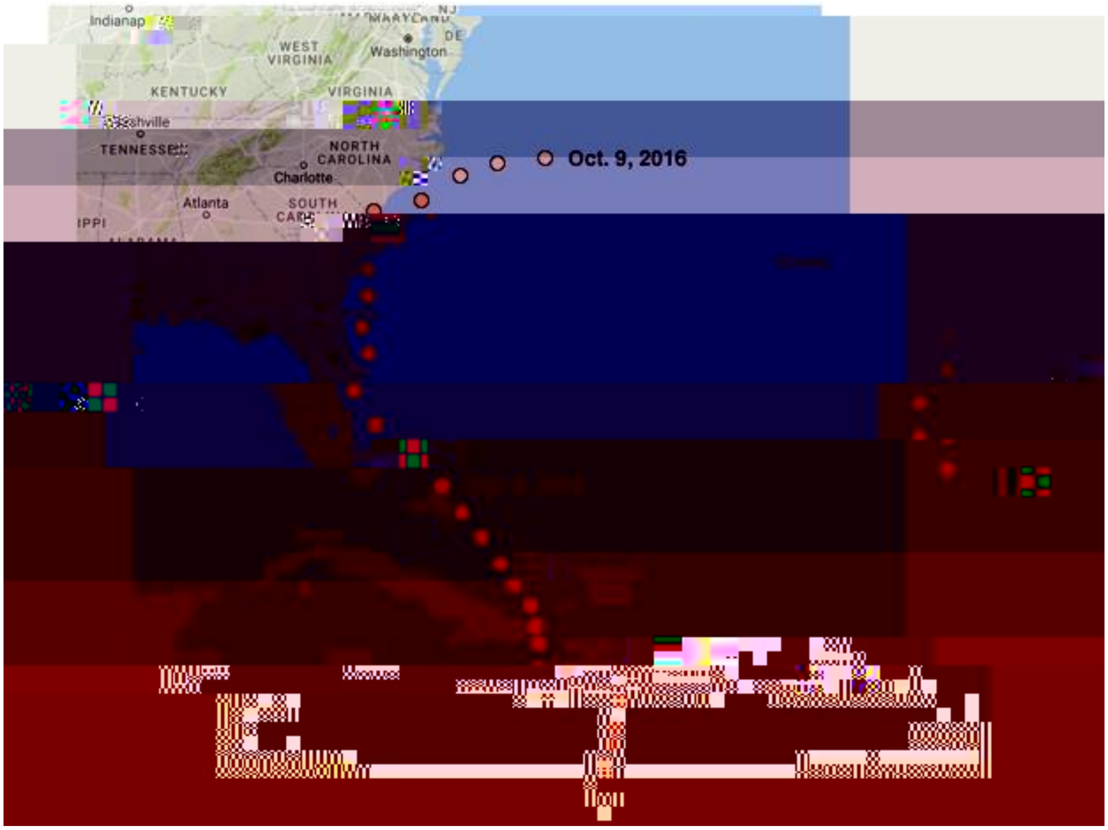
Our results reveal that the hurricane significantly reduced consumer spending in the affected states (Florida, Georgia, South Carolina, and North Carolina) in early October. Although the level of spending after the storm quickly returned to normal, very little of the preceding shortfall appears to have been made up in the subsequent weeks, suggesting that, on net over the span of a few weeks, the hurricane had a negative effect on spending. The drop in activity was most apparent in the discretionary components of spending, such as restaurants, as opposed to necessities, such as grocery stores.[2] The net negative effect on spending implies that inter-temporal smoothing through this temporary shock is either incomplete or slow to occur.

The data we use for this analysis are the outcome of a trial collaboration between the Federal Reserve Board, Palantir Technologies, and First Data Corporation. The anonymized transactions aggregates originate from First Data, an electronic payments processor that provides merchants with the technology to process credit, debit, and electronic payment transactions. Palantir constructed daily indexes of purchases by state and industry for the Board.[3] The daily indexes are available with only a three-day delay so it is possible to study spending almost in real time. The indexes are based on a subset of transactions that excludes variation arising from changes in First Data's client base over time. Even so, the resulting sample is not necessarily representative of all debit, credit, and electronic transactions in the United States; in addition, the data do not include payments made via cash or check.[4] Thus, when we aggregated the detailed industry indexes up to broad spending categories, we applied weights based on each industry's share in the official Census Bureau estimates. In the analysis presented here, we focus on a broad spending measure that we refer to as the "retail sales group."[5] The retail sales group accounts for about one third of total consumer spending and appears to be well measured by the First Data transactions.

The daily, state-level indexes from First Data have no counterpart in the official statistics. Comparisons with Census monthly retail sales data at the national level, however, reveal similar patterns in changes in consumer spending over 2014 to 2016.[6] Figure 1 shows the 12-month percent change in Census retail sales group spending along with comparable estimates from the First Data Retail volume aggregates. The correlation between the two series is 0.8. These and other comparisons provided us some assurance that the state-level estimates are of reasonably high quality.

Figure 1: Twelve-month Percent Changes in Retail Sales Group Spending

Figure 2: Path of Hurricane Matthew



Source: National Oceanic and Atmospheric Administration (NOAA), Hurricane Matthew Advisory Archive, http://www.nhc.noaa.gov/archive/2016/MATTHEW.shtml, mapped with Google Maps api.
Note: Weather data mapped using the ggmap package in R, as presented in Kahle and Wickham (2013).
Accessible version

Using the daily, state-level indexes, we examined the pattern of activity in the days surrounding the occurrence of Hurricane Matthew. Figure 3 shows the index of daily retail sales group spending in Florida from two weeks before the hurricane through two weeks after the storm. The daily aggregates exhibit large, predictable fluctuations in spending across the days of the week. In particular, spending in the retail sales group tends to peak each week on Fridays and records lows on Sundays; however, Hurricane Matthew disrupted this pattern noticeably.

Figure 3: Daily Retail Sales Group Spending in Florida

Source: First Data Retail volume aggregates.
Note: Retail sales group is all retail sales and food services establishments minus motor vehicle dealers, building material stores, and gasoline stations. Not seasonally adjusted.
Accessible version

To quantify the size of the hurricane's effect, we estimated the following regression for each affected state using the daily spending indexes:

In

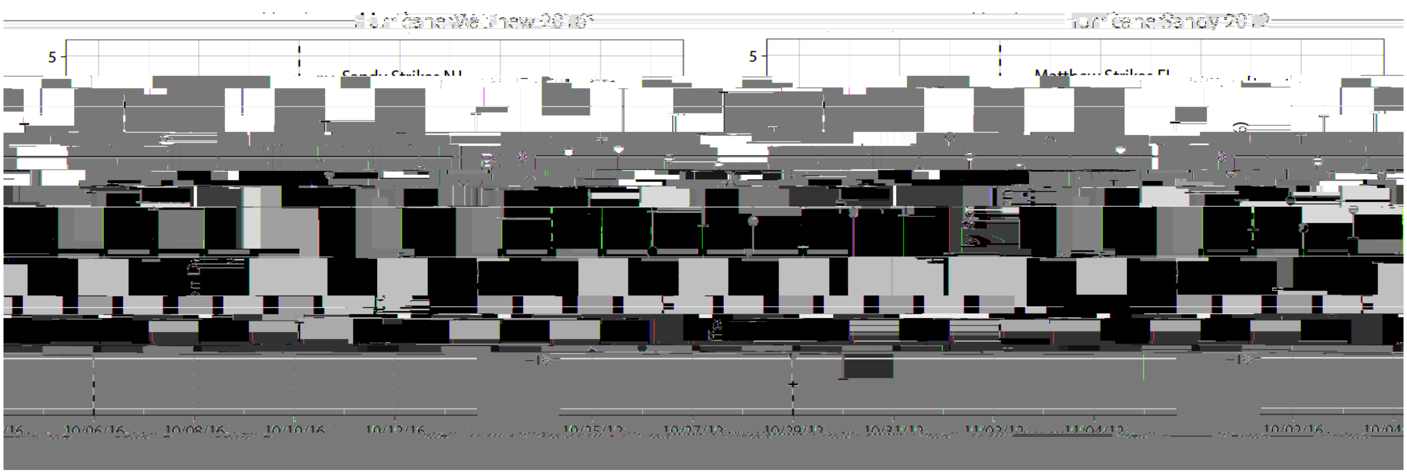
Figure 4: Estimated Effect of Hurricane

Figure 5: Effect of Hurricane Matthew on Selected Components of Daily Retail Sales Group

aggregates provide suggestive evidence that temporary disruptions like hurricanes can have persistent effects on some types of spending.

To quantify the macroeconomic importance of hurricane effects, we separately estimated the regression for retail sales group spending in each of the affected states (Florida, Georgia, South Carolina and North Carolina). We then aggregated the state-level effects using weights based on each state's share of national Census retail sales group spending. Figure 6 illustrates the results of this exercise for Hurricane Matthew and for Hurricane Sandy, another major hurricane that made landfall in October 2012. Notably, we estimate that the macroeconomic impact of Hurricane Sandy was roughly four times as large as Hurricane Matthew. This macroeconomic differential underscores the tremendous variation in the effects of hurricanes and other weather events. In all, our analysis indicates that national spending in the retail sales group in October 2016 was roughly 0.3 percent less than would have occurred in the absence of Hurricane Matthew. Therefore, in contrast to past weather events such as Hurricane Sandy, the imprint of Hurricane Matthew on quarterly measures of GDP will likely be quite small. (Of course, Hurricane Matthew may have disrupted economic activity through other channels such as employment and construction, but these channels are outside the scope of our analysis.)

Figure 6: Effect on Daily National Retail Sales Group Spending by Hurricane



Source: First Data Retail volume aggregates, Census Bureau.
Note: The state-level spending weights used to aggregate up to national effects are from the 2012 Economic Census. The dots are the estimated coefficients for the daily hurricane effects and the whiskers are the 95 percent confidence interval.
Accessible version

Using anonymized daily transaction aggregates at the state level, we estimate that Hurricane Matthew had noticeable negative effects on retail sales group spending in the affected areas in October 2016. We find little evidence that the shortfall in this category of spending is made up in the days prior to and after the storm, suggesting an overall net loss in sales due to the hurricanes. However, because Hurricane Matthew was short-lived and the affected states only represent a small share of national spending, the overall impact of October's storm on quarterly measures of GDP will likely be very small. The daily transaction aggregates offer an extremely valuable means to gain new insights into how consumer spending is affected by unforeseen events like hurricanes.

Busse, Meghan R., Devin G. Pope, Jaren C. Pope, and Jorge Silva-Risso. (2015). "The Psychological Effect of Weather on Car Purchases." *Quarterly Journal of Economics.* 130(1): 371-414.
First Data, *First Data Retail volume aggregates*, https://www.firstdata.com/en_us/home.html.
Kahle, David and Hadley Wickham (2013). "ggmap: Spatial Visualization with ggplot2." *The R Journal.* 5(1). 144-161.
Matheny, Wendy, Shaun O'Brien, and Claire Wang. (2016). "The State of Cash: Preliminary Findings from the 2015 *Diary of Consumer Payment Choice*." Cash Product Office, Federal Reserve System.
Roth Tran, Brigitte (2016). "Blame it on the Rain: Weather Shocks and Retail Sales." Working Paper.
Spies, Kordelia, Friedrich Hesse, and Kerstin Loesch. (1997). "Store Atmosphere, Mood and Purchasing Behavior." *International Journal of Research in Marketing.* 14(1): 1-17.
Starr-McCluer, Martha (2000). "The Effects of Weather on Retail Sales." Finance and Economics Discussion Series, 2000-08. Board of Governors of the Federal Reserve System.

---

1. We thank Aaron Jaffe, Dan Moulton, and their colleagues at Palantir for extensive work and conversations in constructing the state-level aggregates analyzed here. This note is the first of several planned notes that will make use of these new transaction aggregates. Return to text
2. Our results are qualitatively similar to Roth Tran (2016), who found persistent spending effects from weather shocks using store-level data. Return to text
3. First Data client merchants are classified by Merchant Category Codes (MCC). To facilitate comparisons with Census data on retail sales, these MCC codes were mapped to the relevant NAICS 4-digit industry codes. Return to text
4. According to the Federal Reserve's 2015 *Diary of Consumer Payment Choice* survey (see Matheny et al, 2016), cash and checks account for 28 percent of the value of all consumer payments, down from 33 percent in 2012. Return to text
5. The "retail sales group" includes all retail sales and food services other than sales at motor vehicle dealers, building material stores, and gasoline stations; it is the portion of the Census retail sales data that the BEA uses to construct its estimate of personal consumer expenditures. First Data also has good coverage of gasoline stations and some service-industries outside of the retail sales group but does not cover all consumer spending. Return to text
6. Currently the First Data Retail volume aggregates are available beginning in September 2012. Return to text

7. While our analysis focused on spending categories in the retail sales group, we did explore some additional categories. For example, spending at gasoline stations exhibited a significant ramp up of spending before the hurricane, and then a prolonged divot in spending during the hurricane and the subsequent few days, such that that the net effect was roughly zero. Spending in building materials was also significantly higher than normal in the days before and immediately after the hurricane, and the overall net effect for this category was positive. In future analysis, we will likely broaden the scope of our analysis to include other retail categories that are well-measured by the First Data Retail volume aggregates. Return to text

8. In a study of weather effects in national retail sales spending, Starr-McCluer (2000) uses a Becker-style model in which consumption commodities are the product of both market expenditures and time inputs. Weather changes the productivity (or cost) of time use in certain activities outside the home like shopping, and thus changes in market expenditure may be used to smooth out consumption. In such a model, net positive or net negative effects on market spending from weather are possible. Return to text

9. As some examples of related research, Busse, Pope, Pope, and Silva-Risso (2014) find that weather has a psychological effect on car purchases and Spies, Hesse, and Loesch (1997) argue that mood can influence purchases. Return to text

10.