Internet Appendix

Weathering an Unexpected Financial Shock: The Role of Federal Disaster Assistance on Household Finance and Business Survival

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1 Data Appendix

1.1 Tornado Sample

As discussed in Section 3.1 of the main text, the tornado sample includes 34 individual tornadoes. All tornadoes in the sample have a Fujita (F) or Enhanced Fujita (EF) rating of 4 or 5, and a map demarcating heterogeneous intensities within the tornado path. We use the Tornado History Project database (www.tornadohistoryproject.com) to form this sample. We restrict the years to 2002-2013, so as to match the period covered by our individual and business data. The Tornado History Project obtains data from the Storm Prediction Center's (SPC) historical tornado data files (www.spc.noaa.gov/wcm/#data). These data are maintained by the SPC, the National Centers for Environmental Protection, and the National Weather Service (NWS). The Tornado History Project reports 15,247 individual tornadoes from 2002-2013. Restricting to tornadoes with a F/EF rating of a 4 or 5 results in 87 tornadoes.

We further restrict tornadoes in the sample to those which have a detailed map denoting heterogeneous intensities within the tornado path. The tornado maps are created by the NWS. To our knowledge, there is no single location that includes all of the NWS maps with sub-tornado path F/EF ratings. To locate the detailed maps we conducted an extensive search within local NWS office websites, and using more general web-based and archival searches. The search was conducted from June 2013-August 2014.

The key feature of the NWS maps is that they are damage maps created by trained NWS employees who survey the on-the-ground damage. For example, the following link provides details on the May 22, 2011 Joplin, MO tornado: https://www.weather.gov/sgf/news_events_2011may22. The NWS has developed extensive manuals and computer software that relate observable damage to an EF rating. The first step involves documenting the severity of a damaged structure (e.g. detached house, mobile home, tree). The training manuals emphasize paying close attention to both a structure's materials and design, as well as, the state-level building codes. The NWS uses engineering models that relate the type of structure, the observed damage, and the underlying building codes to the range of wind speeds that would most-likely have caused the damage (Edwards et al. [2013]).

The US National Oceanic and Atmospheric Administration (NOAA) provides the following details to the questions "Who surveys tornado damage?" and "What's the criteria for the National Weather Service to do a survey?":

> *"This varies from place to place; and there are no rigid criteria. The responsibility for damage survey decisions at each NWS office usually falls on the Warning-Coordination Meteorologist (WCM) and/or the Meteorologist in Charge (MIC). Budget constraints keep every tornado path from having a direct ground survey by NWS personnel; so spotter, chaser and news accounts may be used to rate relatively weak, remote or brief tornadoes. Killer tornadoes, those striking densely populated areas, or those generating reports of exceptional damage are given highest priority for ground surveys. Most ground surveys involve the WCM and/or forecasters not having shift responsibility the day of the survey. For outbreaks and unusually destructive events–usually only a few times a year–the NWS may support involvement by highly experienced damage survey experts and wind engineers from elsewhere in the country. Aerial surveys are expensive and usually reserved for tornado events with multiple casualties and/or massive degrees of damage. Sometimes, local NWS offices may have a cooperative agreement with local media or police to use their helicopters during surveys."*

Source: https://www.spc.noaa.gov/faq/tornado/index.html#Damage

To our knowledge, the National Weather Service (NWS) maps and personnel are not involved in the disaster assistance decision process. The objective in creating the maps for the NWS is to document and better understand significant metrological events. While the on-the-ground damage assessment occurs shortly after the tornadoes, the final maps are often not published until weeks later.

We include a tornado map in our sample if it contains exact locations of where the tornado hit at various F/EF intensities, and also has sufficient detail that it can be georeferenced using GIS software (ESRI ArcMap). We were able to obtain detailed damage maps for 35 of the 87 F/EF tornadoes in our sample period. Many of the tornadoes for which we could not locate detailed maps occurred in very rural locations and directly hit few, if any, homes or built structures. It is likely that detailed maps were not created for these tornadoes. Regardless, we would not be able to include most of these tornadoes in our sample because there would be insufficient credit bureau or business establishment data (in the Federal Reserve Bank of New York Consumer Credit Panel / Equifax and Infogroup's Historical Business Database, respectively).

Appendix Table 1 lists each of the 35 tornadoes. The table includes the date and location (closest city) of each tornado, and the following statistics provided by the Tornado History Project: fatalities, injuries, and estimated damage. The table also indicates whether each tornado was part of a Presidential Disaster Declaration, whether Public Assistance or Individual Assistance (cash grants) was allocated, and if the tornado is included in our balanced 18 tornado robustness sample. The Ferguson, MO tornado crosses state lines. We classify the Missouri tornado victims as receiving cash assistance and the Illinois tornado victims as not receiving cash assistance.

Our main sample includes 34 tornadoes. We exclude one tornado from the sample (the Wayne, NE tornado in Appendix Table 1). The Wayne, NE tornado has differing pre-tornado trends for the hit and nearby businesses (see Appendix Figure 3). The differing pre-trends violate our key difference-in-differences and triple difference modeling assumption. Moreover, the difference for this tornado is large enough to alter the pre-trends for the entire group of no-aid tornadoes (see Appendix Figure 4). We drop the Wayne, NE tornado from both the business and household finance samples, so as to conduct our main analysis on the same sample of tornadoes.

1.2 GIS Data Processing

1.2.1 Tornado Maps

The goal of the GIS data processing is to use the detailed tornado maps to determine the list of census blocks that are hit by the tornado and the list of census blocks that are just outside the tornado path and located in the 0.5-1.5 mile buffer region.[1] Further, we calculate the percent of each block that incurs each level of F/EF damage in the tornado path. We use the percent of each block hit by the various F/EF damage levels to calculate a weighted damage intensity for every hit block. We also calculate the fraction of the block that is in the buffer region. We only include blocks in our nearby control sample if more than 50% is located in the buffer region. This restriction, along with the half mile gap between the tornado path and our buffer region, helps to ensure that no portion of a nearby control block is also hit by the tornado.

The first step in the GIS process is to georeference the exact location of the tornado path. Occasionally, the tornado maps are available as GIS shapefiles which, after projecting the shapefiles, provide the exact tornado location. More often, we georeference the tornado path location ourselves by adding a US highway/major/minor roads layer within the GIS software (ESRI ArcMap) on top of the tornado damage heterogeneity map. Geographic points are identified on the heterogeneous damage map such as intersections of highways and major/minor roads. The damage maps are then georeferenced by lining up the identified points on the map image with the same points on the US highway/major/minor roads layer.

Next, we calculate the portion of each block (if any) that incurs each level of tornado damage, and the proportion of each block (if any) that falls inside the buffer region. We do this by intersecting the 2000 US Census block shapefile corresponding to the state (or states) hit by each tornado with the georeferenced tornado map. We calculate a block-level weighted intensity measure for each block. The block-level intensity measure is defined as the sum: (0 * %EF0) + (1 * %EF1) + ... + (5 * %EF5). Not all tornadoes have

[1] In robustness analysis we also consider alternative buffer regions, including 1-2 miles.

each damage level. Occasionally, the tornado maps will indicate EF0 damage, whereby the block is clearly located in the tornado path, but there is only minimal damage.

Finally, the block-level tornado information is exported to a .csv datafile. The exported GIS-calculated tornado information is then matched on census block FIPS code to the household finance and business datasets.

1.2.2 Appendix Figure 1 and Table 5

Appendix Figure 1 and Appendix Table 5 use ZIP Code level FEMA Individual Assistance (cash grant) and SBA disaster loan data. We use the detailed georeferenced tornado damage maps discussed in Appendix Section 1.2.1 to obtain the list of "hit" and "buffer" ZIP Codes. To do this, we overlay state-specific 2000 US Census TIGER/Line ZIP Code shapefiles onto each tornado map using ArcGIS. A hit ZIP Code is defined as one which intersects with any portion of the tornado path. For example, in Appendix Figure 1, the following ZIP Codes are hit: 64801, 64804, 64840, 64844. A buffer ZIP Code is one that intersects with the 0.5 to 1.5 mile buffer zone outside of the tornado path and does not intersect with the tornado path. In Appendix Figure 1, ZIP Codes 64841 and 64862 are buffer ZIP Codes. If a ZIP Code is within the buffer zone and the tornado path, we define it as hit.

Note that the ZIP Code definition for hit is different than the one we use for the block-level analysis in the paper. Census blocks are geographically much smaller than ZIP Codes. This allows us to have stricter definitions for hit and buffer areas in the empirical analysis.

1.3 Data Sources

This section lists information on all the data sources used in this project. Further details are provided in the manuscript.

1.3.1 Federal Emergency Management Agency (FEMA) Disaster Assistance

A governor of a US state that experiences a natural disaster must request a Presidential Disaster Declaration in a written letter to their FEMA regional office. Disaster declarations occur at the county-level. The letter must contain a list of proposed counties and preliminary damage estimates. The letter requesting disaster aid is usually sent to FEMA within a couple of days of the event. These letters (some of which we have reviewed) contain preliminary summary information of the disaster such as: the number and names of impacted counties, estimates for the number of people injured/killed, estimates for total damage, estimates for the total number of structures (or blocks) that suffered severe damage, and information on whether the populations affected are more likely to be minority or low income populations (e.g. using Census information). The regional office forwards a recommendation for whether to grant the request to FEMA headquarters. FEMA headquarters then makes an official recommendation to the US president, who decides whether or not to grant the request. The aim of a Presidential Disaster Declaration is to assist with "acts of God" that are of "such severity and magnitude that effective response is beyond the capacities of the state and the affected local governments" (Daniels and Trebilcock [2006]; Disaster Relief Act [1974]).

FEMA is the source of the Presidential Disaster Declaration, Public Assistance, and Individual Assistance data. The FEMA website (https://www.fema.gov/disasters) provides information on whether there is a Presidential Disaster Declaration following the storm that includes each tornado, and whether Public Assistance and Individual Assistance (cash grants) disaster aid is distributed. The publicly available information on the website is typically provided at the disaster-level (and occasionally the county-level).

The Individual Assistance data we use are from a Freedom of Information Act Request (FOIA). FEMA typically discloses either disaster-level or county-level information. We submitted a FOIA (No. 2015-FEFO-00159) in December 2014 for block-level Individual Assistance information. We received the FOIA information in January 2019 (five years later). However, due to confidentiality considerations, FEMA provided 5-digit ZIP Code level information (rather than block level). The information includes: disaster declaration number, ZIP Code, earliest application approval date, total number of housing grants, total amount of housing assistance, total number of other needs assistance (ONA) grants, and total amount of ONA. The information was provided for 23 of the 25 tornadoes in our full sample that are part of Presidential Disaster Declarations with Individual Assistance. We do not have ZIP Code level cash grant information for the 2008 Waterloo, Iowa and 2008 Ridgeville, Georgia tornadoes. We are happy to share all of the FOIA Individual Assistance data.

The county-level Public Assistance information used to calculate the statistic in manuscript Section 3.2 is from a combination of several FOIA requests and data scraped from FEMA's website.

Appendix Table 5 shows summary statistics for the amount of SBA disaster loans awarded to the hit and nearby ZIP Codes following a tornado.

1.3.2 Federal Reserve Bank of New York Consumer Credit Panel

The credit and debt information is from the Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP). The consumer credit panel was first created via a collaboration between researchers at the Federal Reserve Bank of New York and Equifax, a credit repository company. The panel is updated quarterly, and runs from 1999Q1 to the present. Lee and van der Klaauw [2010] provide a comprehensive summary of the information included in the CCP. We are not able to post or share these data due to confidentiality concerns and a strict user agreement.

The CCP consists of a random sample of the population that has a social security number conditional on having a credit history. We use the "primary" CCP sample that does not include other linked household members. Our sample consists only of individuals that are 21 and older in the quarter of the tornado, since individuals do not typically enter the CCP until they are 18 years old and we require them to be in the sample for 12 quarters prior to the tornado.

All dollar denominated variables are in real 2010 dollars. We winsorize the 99th percentile of all dollar denominated stock variables (balances and credit limits) in each quarter so that our estimates are not driven by the presence of extremely large debt balances or credit limits.

Information on Particular Credit Variables

1. **Small Business Association (SBA) loans** are not reported to Equifax.

2. The **Equifax Risk Score** is a trademarked measure of consumer credit risk and ranges from 280-850. A higher score indicates a higher measure of creditworthiness.

3. Bank and retail card accounts (i.e. **credit cards**) cover all types of issuers: banks, bankcard companies, national credit card companies, credit unions, and savings & loan associations, as well as department store and other retail credit cards.

4. The CCP data include a quarterly **foreclosure** variable that indicates whether an individual had a foreclosure in the past seven years. We do not use this variable to examine how offering cash assistance following a tornado affects quarterly foreclosure rates. The reason is due to a combination of three factors: our sample size, the fact that new quarterly foreclosures are very uncommon, and that we need to use an inexact proxy to identify changes in foreclosure.

   Overall, the fraction of our sample that has the foreclosure flag equal to one in the quarter before a tornado ranges from 0.017 to 0.022 across the hit and nearby groups. To measure the rate of new foreclosures we calculate the quarterly *change* in this foreclosure flag. We proxy the quarterly foreclosure rate as quarterly changes in the fraction of individuals with the foreclosure flag equal to one. This proxy is inexact because it will not reflect a new foreclosure if an individual had a foreclosure within the past seven years. This quarterly change in foreclosure is equal to 1 for between 0.1% and 0.5% of the sample in the quarter before the tornado (Appendix Table 3)

Appendix Figure 2 shows our measure of quarterly foreclosure rates for the four groups in our sample relative to when a tornado hit. The average foreclosure rate is approximately 0.002 across the groups and is an order of magnitude smaller than the (seven year) sample means reported in the CCP for our sample. Moreover, the foreclosure rate proxy is zero for at least one quarter for each of the four groups, and equal to zero for the majority of quarters for the hit group without access to cash assistance. Overall, we interpret Appendix Figure 2 as evidence that we do not have enough power to estimate changes in foreclosures using the seven year foreclosure flag in our setting.

1.3.3 Infogroup's Historic Business Database

We use business establishment data from the Infogroup's Historic Business Database. Infogroup compiles this information by first identifying business establishments through numerous sources, including: county-level public sources, utility connects and disconnects, real estate tax assessor data, yellow and white pages, and web research. Infogroup then calls every establishment in the US every year.

Whether an establishment exists is not based on a survey response. Throughout the manuscript we emphasize the survival of establishments for this reason.

The employee and sales data are based on surveys (and not, for example, copies of business payroll documents). As such, the number of employees and level of sales could involve misreporting. Still, we have no reason to expect that there is mis-measurement in the business employment and sales information, apart from the fact that the information is survey-based. To the contrary, an independent audit by the College of Information Science & Technology at the University of Nebraska at Omaha found the database similar to, and on many dimensions, of higher quality than other private establishment-level datasets such as the National Establishment Time-Series (NETS) dataset (College of Information Science & Technology at the University of Nebraska [2017]). These data have also been used in prominent business studies (e.g. Serreto and Zidar [2016] published in the *American Economic Review*). Moreover, the pattern of our results is very consistent between the survival estimates, and the employment/sales estimates. For example, the estimates for both sets of outcomes are consistent in their relative order and magnitude across the low, medium, and high damage blocks.

We are not able to post or share these data due to a strict user agreement.

1.3.4 Small Business Administration (SBA)

There are several ways to make SBA disaster loans available, including: a Governor Certification Declaration for businesses and an Administrative Declaration for individuals (SBA [2015]). SBA disaster loans are available to both individuals (households) and businesses. Individuals can apply for up to $240 thousand, while businesses can apply for up to $2 million (SBA [2018]). Loan amounts are based on verified losses (i.e. building damage, personal property, business property). Small businesses can also receive loans based on "economic injury" (e.g. documented income loss). Loan applicants do not need collateral, but must demonstrate credit worthiness. Less than half of all applications are approved (e.g. Collier and Ellis [2021]).

Annual SBA disaster loan data are publicly available at the 5 digit ZIP Code level separately for home and business loans. We downloaded the data directly from the SBA website https://www.sba.gov/offices/headquarters/oda/resources/1407821 (FY 2001-2013). The SBA information includes dollar amounts for: real estate loss, content loss, real estate loans, and (for businesses) economic injury loans.

Appendix Table 5 shows that total verified losses are higher for loan applicants in areas hit by disaster assistance tornadoes. However, the average amount of approved loans is slightly lower for disaster assistance tornadoes (e.g. $1.32 million vs. $1.41 million for home loans). By contrast, the total verified business loss and total approved business loans are both higher for establishments hit by tornadoes with disaster assistance. This table is referenced in manuscript Section 3.2.

1.3.5 Tornado History Project

The Tornado History Project, http://www.tornadohistoryproject.com, is a searchable database that archives all reported US tornadoes from 1950-2017. The underlying source of the tornado information is the Storm Prediction Center's (SPC) historical tornado data file (https://www.spc.noaa.gov/wcm/#data). The Storm Prediction Center is part of the National Weather Service and the National Centers for Environmental Prediction. Tornado cost, casualty, and maximum intensity information are from the Tornado History Project.

1.3.6 US Decennial Census

We use two sources of data from the US Census. First, are the demographic and socioeconomic information from the 2000 decennial census. These data are used as part of a pre-tornado comparison between hit and nearby populations. We only use Census outcomes aggregated at the block-level. The means of key Census variables are displayed in Appendix Table 3. Second, are 2000 decennial census block shapefiles. We use the shapefiles in the GIS data processing.

1.3.7 Voting Information

We collect county-level vote share data from uselectionatlas.org. For each PDD county, we calculate the average share of the two party (Democratic and Republican) vote that the losing party receives across the 1996, 2000, and 2004 presidential elections. We use these data to calculate the "Electoral Competitiveness of State" (see Appendix Table 2).

2 Supporting Analysis

2.1 Main Samples

This section provides supporting analysis for the main household finance and business establishment samples that include 34 tornadoes. The tables and figures in this section are directly referenced in the manuscript.

Appendix Figure 1 shows the total amount of Individual Assistance cash grants received for each ZIP Code in the vicinity of the May 22, 2011 Joplin, MO tornado. The majority of the tornado path and nearly all of the most highly damaged areas occur in a single ZIP Code (64804). More than $12 million is provided to residents in this ZIP Code. Nevertheless, the tornado only hits 9.95% of the land area of the ZIP Code. Some residents in portions of the ZIP Code farther away from the tornado path likely experienced minor storm-related damage and receive cash assistance. As evidence for this, all of the ZIP Codes surrounding the tornado path have non-zero levels of cash assistance. The majority of these ZIP Codes (colored light blue in the figure) receive much smaller levels of total cash grants, ranging from $408 to $301,382. This figure is referenced in manuscript Section 3.2.

Appendix Figure 2 plots quarter to quarter changes in the foreclosure rate, as proxied by the fraction of each group with the seven year foreclosure flag equal to one. The four groups are individuals hit and nearby to aid and no-aid tornadoes, respectively. The vertical line indicates the last quarter before a tornado. Foreclosure is referenced in manuscript Section 5.1.

Appendix Figure 3 plots means of the residuals from a regression of block-level establishment outcomes on year dummy variables for establishments in blocks that are part of the disaster aid group in our our preferred sample, and for the Wayne, NE Tornado (a no-aid tornado). The left side of the figure plots the trends separately for tornadoes where affected residents were able to access cash grants (circles) and the Wayne, NE tornado, where no cash grants were distributed (triangles). The right side of the figure plots the difference in establishment outcomes between blocks hit by and nearby to a tornado. The Wayne, NE tornado is omitted from the main 34 tornado sample due to divergent pre-tornado business trends. This figure is referenced in manuscript Section 4.

Appendix Figure 4 shows the trends in the number of establishments and employees for establishments located in hit Census blocks at the time of a tornado, and for establishments near, but outside the tornado path. The no-aid tornado trends include hit and control blocks from the Wayne, NE tornado. This figure is referenced in manuscript Section 4.

Appendix Figure 5 shows the distribution of establishments by employment size for the 34 tornado sample analyzed in Table 6 of the manuscript. This figure is referenced in manuscript Section 6.2.2.

Appendix Figure 6 shows the hit minus nearby difference for new quarterly auto loans and log sales for retail and service establishments. We plot the differences separately for aid and no-aid tornadoes, after first taking the mean residuals from a regression that controls for calendar time. The left panel shows that the difference in new vehicle loans for hit and nearby individuals oscillates around zero for the entire time period with two exceptions: an increase for the aid group right after the tornado, and a year-long decrease for the no-aid group beginning two quarters post-tornado. The right panel shows that sales plummet for hit retail and service establishments in neighborhoods with no disaster assistance.

Appendix Table 1 shows summary information for all 35 tornadoes in our full sample. The 35 tornadoes are the subset of the 87 Fujita or Enhanced Fujita 4 and 5 tornadoes that struck the US between 2002-2013 which have detailed damage path maps. Manuscript Section 3.1 and Appendix Section 1.1 provide more details.

Appendix Table 2 provides summary information for the tornadoes in our main sample. We reference the table in Manuscript Section 3.2.

Appendix Table 3 shows the means of key variables from three data sources. The means are calculated separately for individuals hit and nearby aid and no-aid tornadoes. Panels A-C show information from the CCP, Census, and Infogroup, respectively. We reference the table in both Manuscript Section 3 and Appendix Section 1.3.

Appendix Table 4 shows the means of key variables separately for low, medium, and high damage blocks. Columns 4-6 calculate the standardized difference in means for the two-way comparisons between the three damage block groups. We reference this table in Manuscript Section 4.

Appendix Table 5 shows summary statistics for the amount of SBA disaster loans awarded to the hit and nearby ZIP Codes following a tornado. This table is referenced in Manuscript Section 3.2.

Appendix Tables 6 and 7 show difference-in-differences estimates for individual debt and financial health using the CCP. We separately estimate the model for aid and no-aid tornadoes for each dependent variable. These tables are referenced in Manuscript Section 6.1.

Appendix Table 8 shows difference-in-differences model results for home debt conditional on whether an individual affected by a tornado (either hit or nearby) moved or stayed in the same census block following the tornado, and by type of home debt. Columns 1-2 only include individuals who move (for at least one quarter) at any point during the three years following the tornado. Columns 3-4 only include individuals who do not move. Our main measure of home debt includes both mortgage debt and home equity debt. Columns 5-6 only consider mortgage debt, while columns 7-8 only consider home equity debt. The increase in first mortgage debt and drop in home equity debt shows evidence of debt consolidation, but may be mechanical driven by people moving from a damaged home to a new home. This table is referenced in Manuscript Section 6.1.

Appendix Tables 9 and 10 show survival and employment triple difference estimates for establishments in each of the SIC "1 digit" industries that we pool together in the non-manufacturing category (Manuscript Table 6). These tables are referenced in Manuscript Section 6.2.2.

Appendix Table 11 shows our triple difference estimates for the number and dollar amount of new auto loan originations, and for establishment sales. Note that, unlike our other CCP dollar debt variables, we do not winsorize at the 99% level. The reason is that the new dollar loan variable is a flow variable with a median of $0. A decision to winsorize would affect a large fraction of the non-zero values. Nevertheless, the regression results are similar regardless of the decision to winsorize. These results are referenced in Section 6.2.3.

Appendix Table 12 shows triple difference heterogeneity estimates for new car loans and new car loan balances. The model is estimated separately on two groups of individuals (lower and upper terciles) based on available credit (panel A), Equifax Risk Score (panel B), and age (panel C). As in Appendix Table 11 we do not winsorize the new auto loan variable at the 99% level.

2.2 Robustness

2.2.1 Figures

Appendix Figure 7 shows the trends in the number of establishments and employees for establishments located in a hit Census block at the time of a tornado, and for establishments nearby, but outside the tornado path. The figure plots residual means from a regression of block-level establishment outcomes on year dummy variables. The horizontal axis shows tornado event time. The trends are plotted relative to when the tornado occurred. The vertical line at -1 indicates the last year before the tornado, while points to the right of the vertical line are years after the tornado.

Overall, Appendix Figure 7 shows that the reduction in the number of establishments and employees in blocks that are hit and do not receive disaster aid is driving the triple difference model results. The left side of Appendix Figure 7 plots the trends separately for disaster aid tornadoes (circles) and no-aid tornadoes (triangles). Three facts emerge. First, trends for the two outcomes in the years leading up to a tornado are roughly parallel for the hit and nearby establishments affected by a no-aid tornado (dashed lines). The same is true for hit and nearby establishments of aid tornadoes (solid lines). Second, the trends in establishment outcomes are increasing slightly in areas that are later hit by a disaster aid tornado. The trends are flatter for establishments which are later affected by a no-aid tornado. Third, in the four years after a tornado, the trend in the number of establishments and employees is flat for establishments affected by tornadoes where residents received disaster aid. During the same post-tornado period there is a reduction in the number of establishments and employees in areas hit by tornadoes where residents did not receive disaster aid. The reduction is greatest in neighborhoods hit by no-aid tornadoes.

The right side of Appendix Figure 7 plots the difference in establishment outcomes between blocks hit by and nearby a tornado. This difference is plotted separately for tornadoes where residents did and did not receive disaster aid. The triple difference model assumes that in the absence of disaster aid the difference in outcomes after a tornado would be the same for the two groups. The trends to the left of the vertical line are roughly parallel, providing evidence for the validity of the key triple difference model identifying assumption.

Appendix Figures 8 and 9 estimate a binary imputation-based DiD event study model following Borusyak et al. [2021]. The eight panels in Appendix Figure 8 show the binary event study model estimates for our individual financial and migration outcomes using the entire sample (i.e. matching the sample in Manuscript Figure 3). The nine panels in Appendix Figure 9 show the binary event study estimates for our three business outcomes for establishments in low, medium, and high damage blocks. Appendix Figure 9 matches the binned samples in Manuscript Table 2. We estimate the binned samples for our business outcomes since there are only three outcomes and it is manageable to display all the figures on one page. We estimate the models using the Stata software packages provided by Borusyak et al. [2021]. Finkelstein et al. [2021] use a similar imputation approach to estimate an event study model for prescription opioid abuse.

The recent methodological literature on event studies has shown several potential limitations with the OLS event study model. These limitations include a strong assumption regarding the homogeneity of the event time treatment effects across calendar time and individuals, and that OLS estimation may not lead to sensibly weighted (event time) treatment parameters. Borusyak et al. [2021] propose an imputation-based estimation approach that allows for unrestricted treatment effect heterogeneity, while avoiding the parameter weighting problem.

The imputation approach can be summarized as follows. First, estimate a binary treatment version of Manuscript Equation 1 that includes only the unit and calendar time fixed effects (omitting the event study coefficients), and using only those observations that have not yet been hit by a tornado during our panel. Second, estimate a counterfactual outcome, $\hat{Y}_{it}(0)$, for each post-tornado, hit observation using the estimated unit and calendar time fixed effects from the first step. Third, calculate the effect of being hit by a tornado for each hit observation as: $\hat{\tau_{it}} = Y_{it} - \hat{Y}_{it}(0)$. The estimated event study coefficients, $\hat{\tau_h}$ (for $h \geq 0$), are calculated as a weighted sum of individual treatment effects for period h, with weights equal to the number of individual treatment effects. Our panel is balanced in event time, so each $\hat{\tau_{it}}$ is weighted equally when calculating $\hat{\tau_h}$.

The Borusyak et al. [2021] approach still estimates the pre-tornado event study coefficients using OLS. The model estimates a binary treatment version of Manuscript Equation 1 that includes only the pre-tornado event study coefficients, where the earliest event time indicator is omitted as a reference period. The model is run only for observations that have not yet been hit by a tornado (including control observations from the buffer areas). An important advantage of estimating the pre-tornado coefficients using non-hit observations only, is that this avoids estimation bias that could occur if we were to use a sample that includes hit observations when there is treatment effect heterogeneity (e.g. Sun and Abraham [2021]).

In general, it is possible to estimate a triple difference model using the Borusyak et al. [2021] approach. However, it is not possible to do so in our setting. The reason is that their framework requires the triple difference to be expressed as a 3-way fixed effects model. This rules out cases such as ours where one of the differences involves comparing outcomes between one set of our fixed effects (individuals affected by an aid tornado) and another set of fixed effects (individuals affected by a no-aid tornado).

2.2.2 Tables

This section provides supporting robustness analysis for our main difference-in-difference and triple difference models.

Appendix Table 13 shows comparative statistics for individuals and business establishments hit by and near to a tornado using the 18 tornado balanced sample. The balanced sample is discussed in Manuscript Section 4.

Appendix Table 14 shows household finance and migration estimates for being hit by a tornado from four robustness specifications using the DiD continuous damage model. Panel A reproduces the estimates using our main model (Manuscript Table 1, panel A). Panel B estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Panel C estimates a stacked regression model (e.g. Cengiz et al. [2019]). Panel D estimates our balanced sample model that more closely matches the levels of key variables. Panel E estimates a model that includes the Wayne, NE tornado.

Appendix Table 15 shows household finance and migration estimates for being hit by a tornado from four robustness specifications using the triple difference continuous damage model. Panel A reproduces the estimates using our main model (Manuscript Table 3, panel A). Panel B estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Panel C estimates a stacked regression model (e.g. Cengiz et al. [2019]). Panel D estimates our balanced sample model that more closely matches the levels of key variables. Panel E estimates a model that includes the Wayne, NE tornado.

Appendix Table 16 estimates robustness specifications using the continuous damage model with ln(business establishments) as the dependent variable. Panel A estimates the DiD model, while panel B estimates the triple difference model. Column 1 reproduces the estimates using our main models (Manuscript Table 2, panel A, column 1; Manuscript Table 5, panel A, column 1). Column 2 estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Column 3 estimates a stacked regression model (e.g. Cengiz et al. [2019]). Column 4 estimates our balanced sample model that more closely matches the levels of key variables. Column 5 estimates a model that includes the Wayne, NE tornado.

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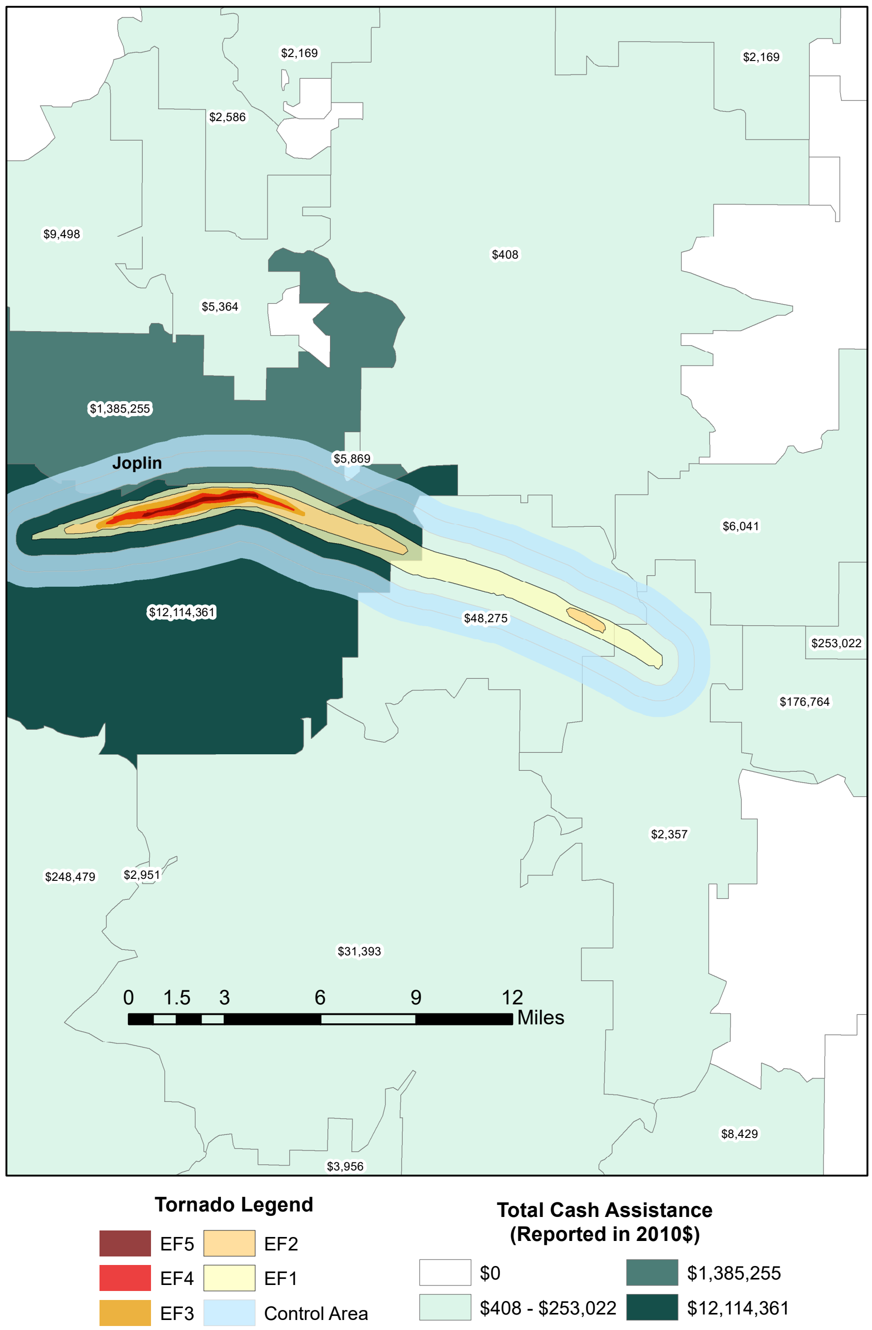
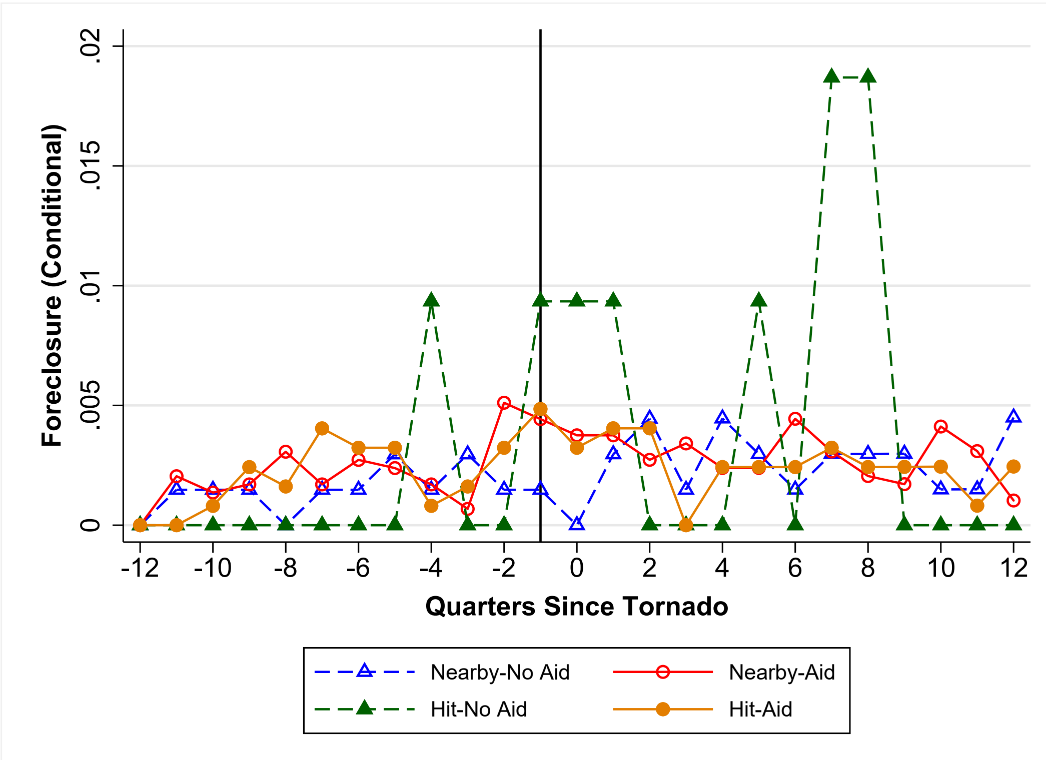
4 Figures and Tables

Figure 1: **Individual Assistance Cash Grants for the Presidential Disaster Declaration that includes the Joplin, MO 2011 Tornado**



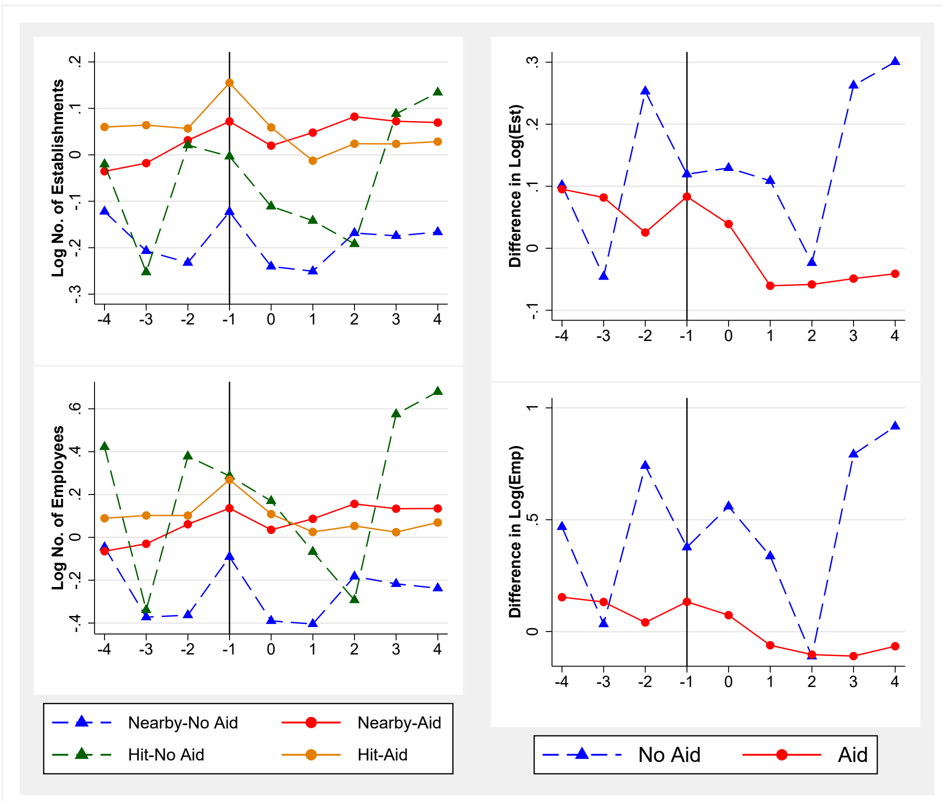
The figure plots the tornado path and 0.5-1.5 tornado buffer region for the EF5 tornado that struck near Joplin, MO on May 22, 2011. The figure also displays the total amount of Individual Assistance cash grants received for each ZIP Code. Sources: Federal Emergency Management Agency, National Weather Service, US Census.

Figure 2: **Trends in New Foreclosures**



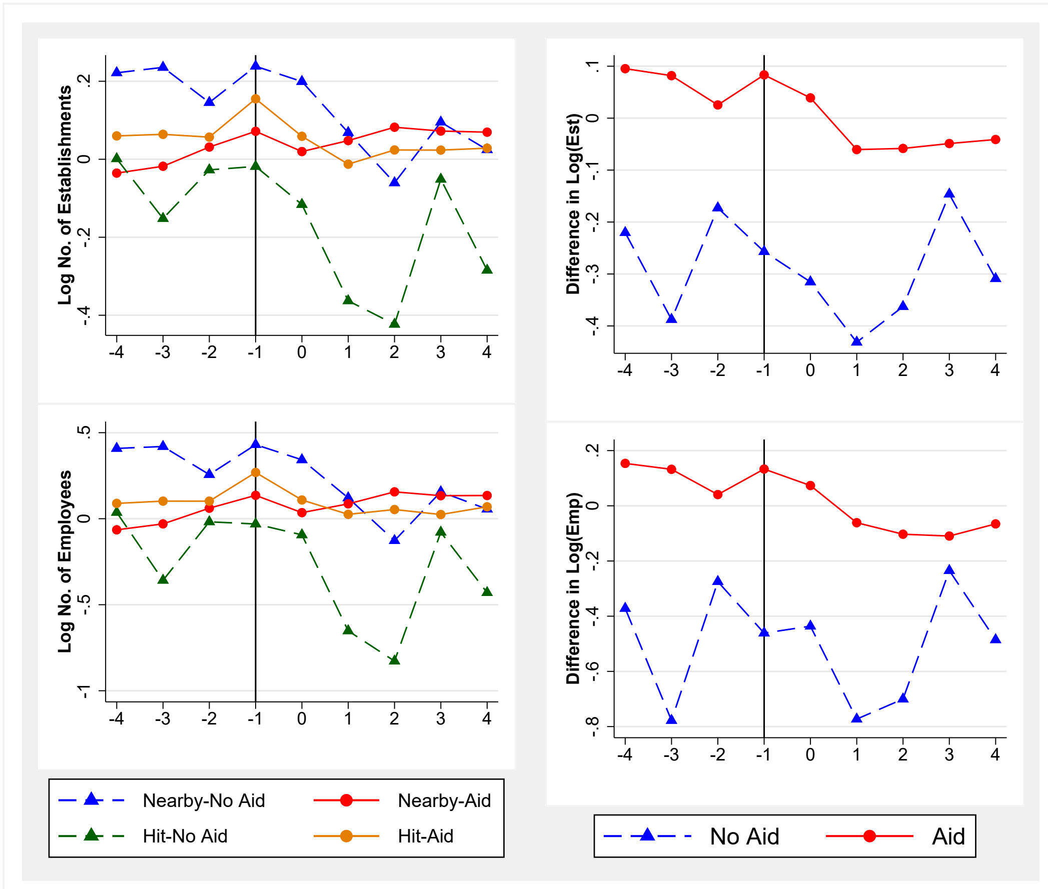
The figure plots quarter to quarter changes in the foreclosure rate, as proxied by the faction of each group with the seven year foreclosure flag equal to one. The four groups are: non-hit residents who lived in the 0.5 to 1.5 mile buffer area around the tornadoes that did not receive cash grants (dashed blue triangles), hit residents who lived in the damage path of tornadoes that did not receive cash grants (dashed green triangles), non-hit residents who lived in in the buffer areas of the tornadoes that did receive cash grants (solid red circles), and hit residents from tornadoes that received cash grants (solid orange circles). The vertical line indicates the last quarter before a tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Figure 3: **Trends in Business Outcomes for the Sample of Disaster Assistance Tornadoes and the No-Aid Wayne, NE Tornado Excluded from the Main Sample**



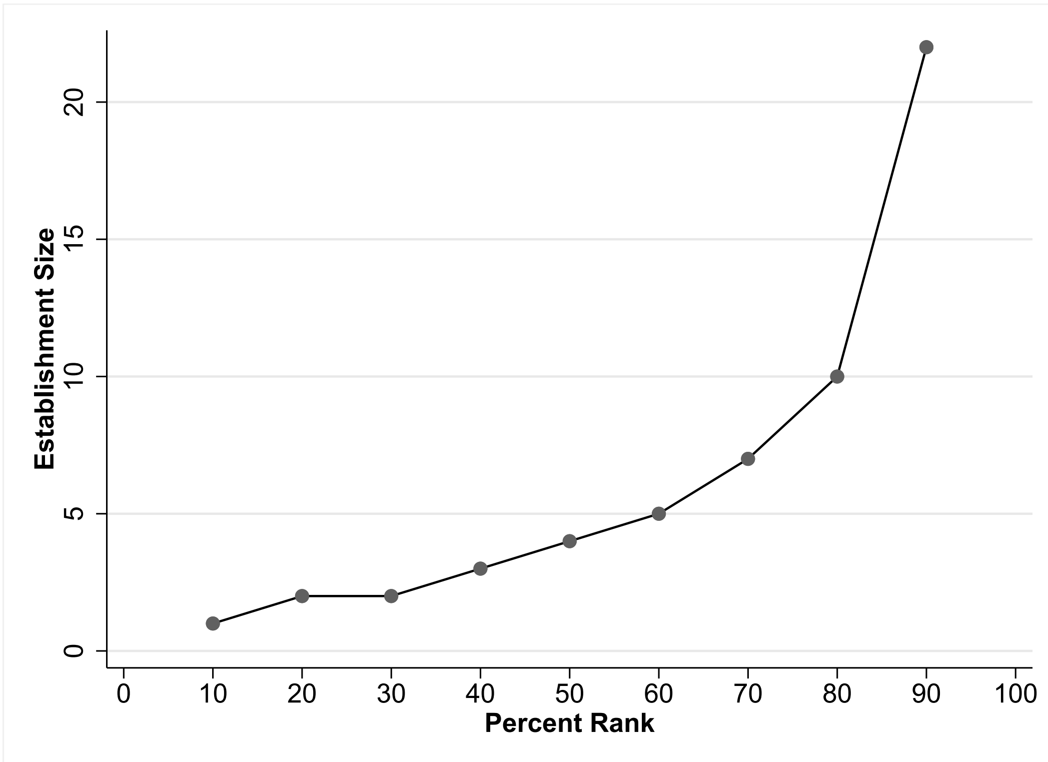
The figure plots means of the residuals from a regression of block-level establishment outcomes on year dummy variables for establishments in blocks that are part of the disaster aid group in our our preferred sample, and for the Wayne, NE Tornado (a no-aid tornado). The left side of the figure plots the trends separately for tornadoes where affected residents were able to access cash grants (circles) and the Wayne, NE tornado, where no cash grants were distributed (triangles). The right side of the figure plots the difference in establishment outcomes between blocks hit by and nearby to a tornado. Sources: Infogroup Historic Business Database, National Weather Service, US Census.

Figure 4: **Trends in Business Outcomes, 35 Tornado Sample Including the Wayne, NE Tornado**



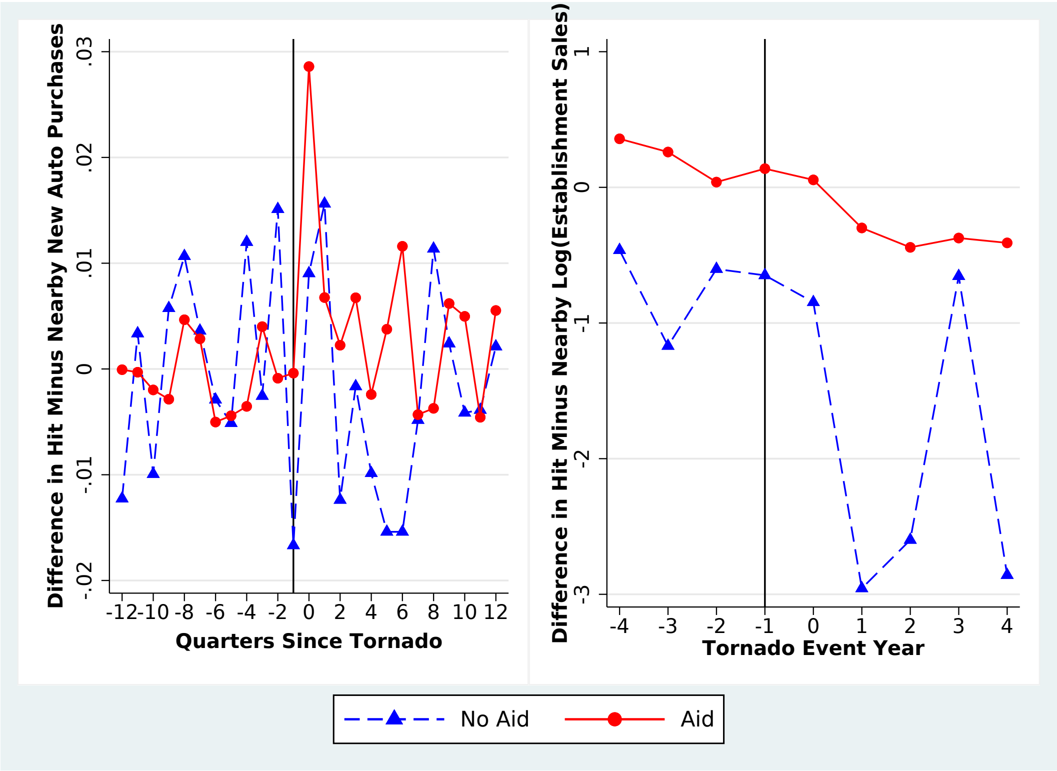
The figure plots means of the residuals from a regression of block-level establishment outcomes on year dummy variables for establishments in blocks that are part of the disaster aid group in our our preferred sample, and for the no-aid group that includes the Wayne, NE Tornado. The left side of the figure plots the trends separately for tornadoes where affected residents were able to access cash grants (circles) and where no cash grants were distributed (triangles). The right side of the figure plots the difference in establishment outcomes between blocks hit by and nearby to a tornado. Sources: Infogroup Historic Business Database, National Weather Service, US Census.

Figure 5: **Distribution of Establishment Size by Number of Employees**



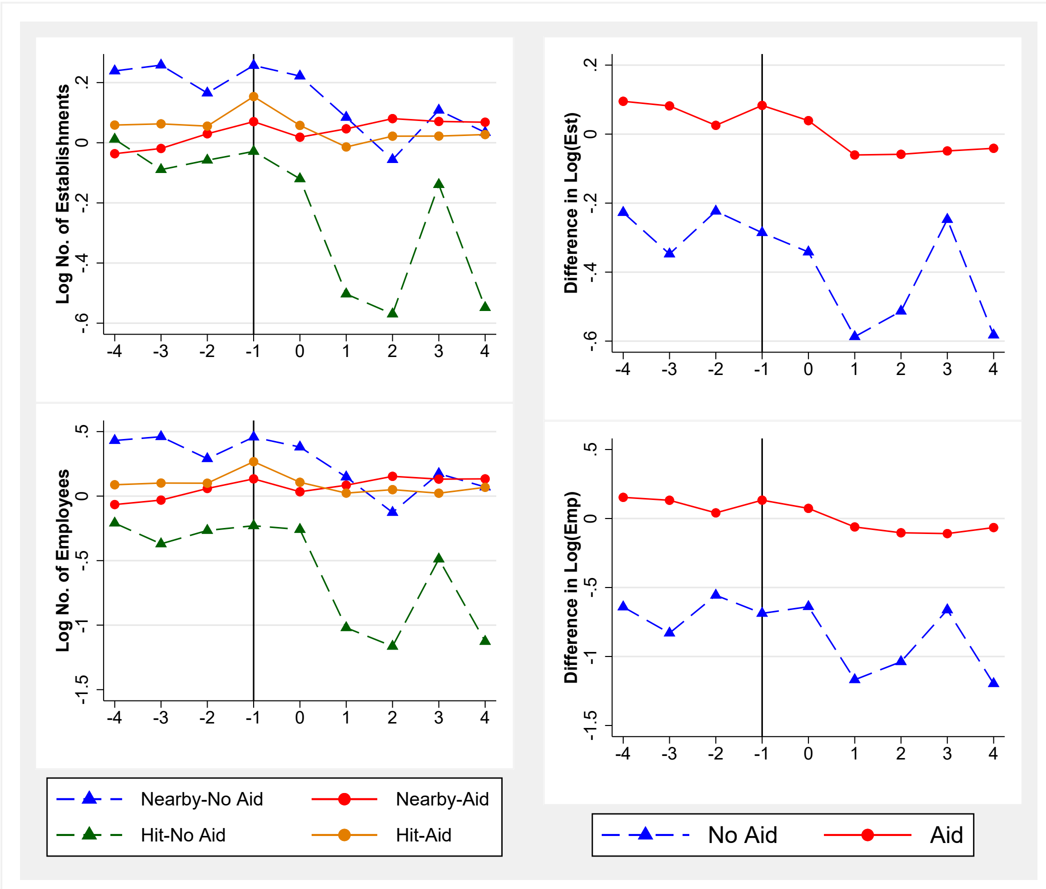
This figure shows the distribution of establishments by employment size for the main 34 tornado sample. Sources: Infogroup Historical Database, National Weather Service

Figure 6: **Trends in Motor Vehicle Purchases and Business Establishment Sales**



The figure shows trends in the hit minus nearby difference for new quarterly auto loans and establishment-level log sales. We plot the differences separately for aid and no-aid tornadoes, after first taking the mean residuals from a regression that controls for calendar time. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

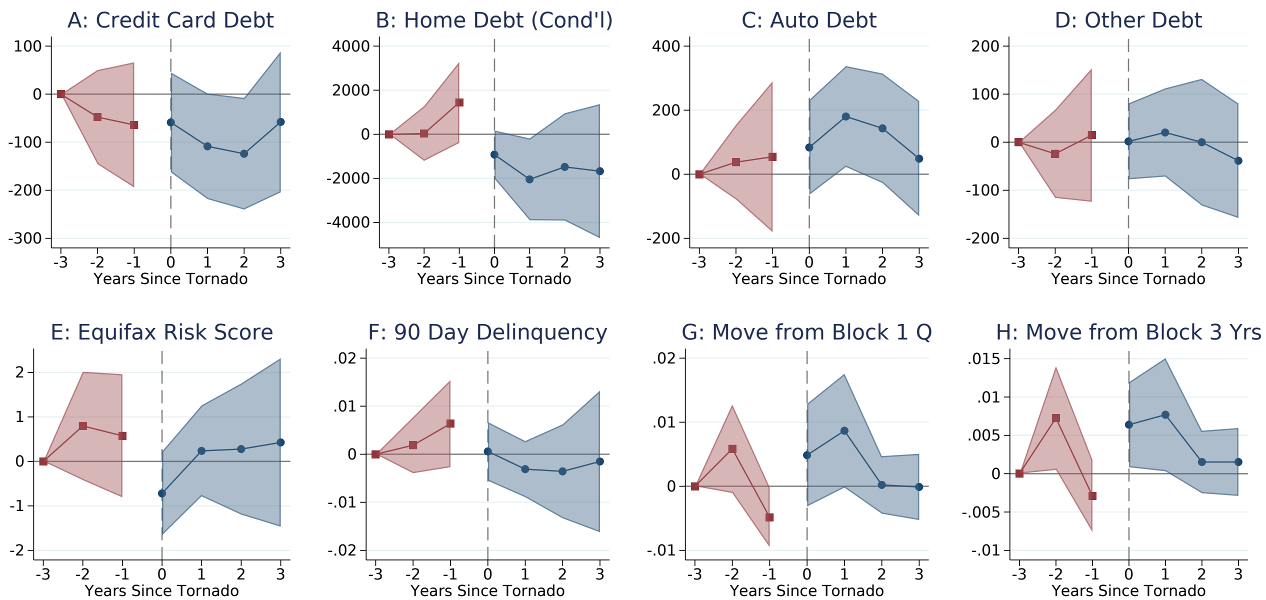
Figure 7: **Trends in Business Outcomes**



The figure plots means of the residuals from a regression of block-level establishment outcomes on year dummy variables for our preferred sample. The left side of the figure plots the trends separately for tornadoes where affected residents were able to access cash grants (circles) and where no cash grants were distributed (triangles). The right side of the figure plots the difference in establishment outcomes between blocks hit by and nearby to a tornado. Sources: Infogroup Historic Business Database, National Weather Service, US Census.

Figure 8: **Impact on Debt, Financial Wellbeing, and Migration of being Hit by a Tornado**

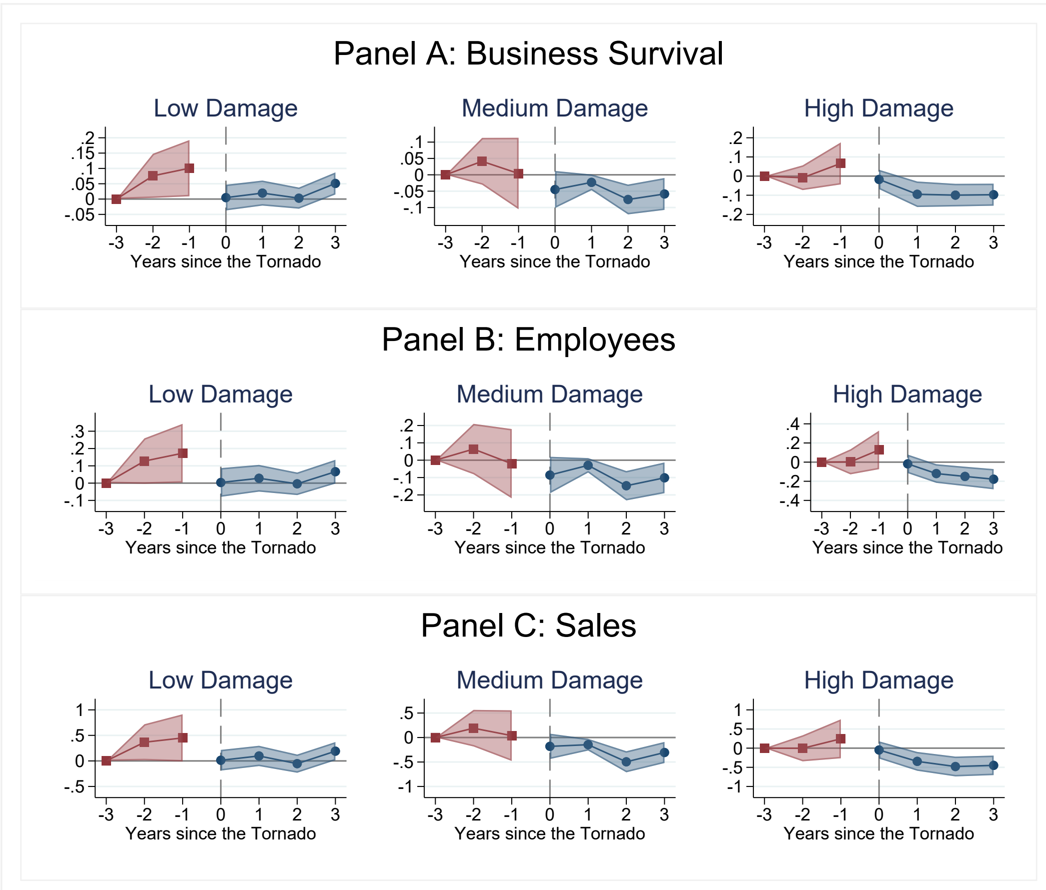
Robustness Binary Event Study Model



The figure plots binary treatment DiD event study estimates for our main household finance and migration outcomes following Borusyak et al. [2021]. The dashed vertical line indicates the *quarter* of the tornado. All other plotted coefficients are yearly. The post-tornado coefficients are estimated using an imputation-based method, and are relative to the year before a tornado. The pre-tornado yearly event time coefficients (squares) are estimated using OLS with three years before the tornado as the reference period. The shaded regions represent the 95% confidence intervals. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Figure 9: **Impact on Business Survival, Employment, and Sales from being Hit by a Tornado**

<u>Robustness Binary Event Study Model</u>



The figure plots binary treatment DiD event study estimates for low, medium, and high damage blocks for our business establishment outcomes following Borusyak et al. [2021]. The dashed vertical line indicates the *quarter* of the tornado. All other plotted coefficients are yearly. The post-tornado coefficients are estimated using an imputation-based method, and are relative to the year before a tornado. The pre-tornado yearly event time coefficients (squares) are estimated using OLS with three years before the tornado as the reference period. The shaded regions represent the 95% confidence intervals. Sources: Infogroup Historic Business Database, National Weather Service, US Census.

Table 1: **Location, Damage, and Federal Assistance Information for All 35 Tornadoes**

Date of Tornado	Nearby City	Tornado F/EF	Fatalities	Injuries	Casualties	Estimated Damage (Millions)	Presidential Disaster Declaration	Public Assistance	Individual Assistance	Included In Balanced Sample
4/28/2002	La Plata, MD	4	3	122	125	$124.00	Y	Y	Y	Y
11/10/2002	Van Wert, OH	4	4	17	21	$30.00	Y	N	Y	N
5/4/2003	Jackson, TN	4	11	86	97	$40.00	Y	Y	Y	N
5/8/2003	Moore, OK	4	0	134	134	$370.00	Y	Y	Y	N
5/22/2004	Lincoln, NE	4	1	38	39	$160.22	Y	Y	Y	Y
3/1/2007	Enterprise, AL	4	9	50	59	$250.00	Y	Y	Y	N
5/4/2007	Greensburg, KS	5	11	63	74	$250.00	Y	Y	Y	N
2/6/2008	Moulton, AL	4	4	23	27	---	N	N	N	Y
2/6/2008	Flat Rock, AL	4	1	12	13	$2.00	N	N	N	Y
5/11/2008	Ridgeville, GA	4	0	9	9	$12.50	Y	Y	N	Y
5/25/2008	Waterloo, IA	5	9	70	79	$100.30	Y	Y	Y	N
6/11/2008	Manhattan, KS	4	0	0	0	$66.00	Y	Y	N	Y
2/10/2009	Ardmore, OK	4	8	0	8	$3.00	Y	Y	Y	Y
4/10/2009	Murfreesboro, TN	4	2	58	60	$100.00	Y	Y	N	Y
6/5/2010	Millbury, OH	4	7	28	35	$102.40	N	N	N	Y
11/29/2010	Winnfield, LA	4	0	0	0	$0.75	N	N	N	Y
4/22/2011	Ferguson, MO	4	0	5	5	$30.00	Y	Y	Y	N
4/27/2011	Chattanooga, TN	4	20	335	355	$68.25	Y	Y	Y	N
4/27/2011	Tuscalousa, AL	4	64	1,500	1,564	$2,450.00	Y	Y	Y	N
4/27/2011	Huntsville, TN	5	72	145	217	$1,290.00	Y	Y	Y	N
4/27/2011	Birmingham, AL	4	22	85	107	$366.76	Y	Y	Y	Y
4/27/2011	Chattanooga, TN	4	1	0	1	$0.03	Y	Y	Y	N
4/27/2011	Fort Payne, AL	5	25	0	25	$0.15	Y	Y	Y	Y
4/27/2011	Hamilton, AL	5	23	137	160	$14.40	Y	Y	Y	Y
4/27/2011	Cullman, AL	4	6	48	54	---	Y	Y	Y	N
5/22/2011	Joplin, MO	5	158	1,150	1,308	$2,800.10	Y	Y	Y	N
5/24/2011	Booneville, AR	4	4	27	31	$9.08	Y	Y	Y	N
3/2/2012	Crittenden, KY	4	4	8	12	$20.50	Y	Y	Y	Y
5/15/2013	Decordoya, TX	4	6	54	60	$143.00	N	N	N	Y
5/19/2013	Norman, OK	4	2	10	12	---	Y	Y	Y	N
5/20/2013	Moore, OK	5	24	212	236	$2,000.00	Y	Y	Y	N
10/4/2013	Sergeant Bluff, IA	4	0	0	0	$2.01	N	N	N	Y
10/4/2013	Wayne, NE	4	0	15	15	$0.50	Y	Y	N	N
11/17/2013	Peoria, IL	4	3	125	128	$935.23	Y	N	Y	Y
11/17/2013	New Minden, IL	4	2	2	4	---	Y	N	Y	Y

The table shows summary information for all 35 tornadoes in our full sample. Sources: Tornado History Project, National Weather Service, Small Business Administration, US Census.

Table 2: **Tornado Damage Characteristics**

Panel A: Overall Sample Characteristics

Total Number of Tornadoes	34
Individual Assistance (Cash Grants)	25
Tornado Damage Severity	
F5/EF5 Tornadoes	7
F4/EF4 Tornadoes	27
States hit by Tornado	15

Panel B: Characteristics by Disaster Assistance Status

	Assistance Mean (Median)	No Assistance Mean (Median)
Disaster-Level		
Number of Counties in Disaster Declaration	34.8 (23)	7.1 (0)
Percent State Counties in Disaster Declaration	42.8 (29)	6.8 (0)
Electoral Competitiveness of State	42.8 (41.9)	43.9 (44.1)
Tornado-Level		
Tornado F/EF Rating	4.3 (4)	4.0 (4)
Number of Damaged Blocks	381 (233)	58 (45)
Estimated Tornado Damage (Millions $)	513 (150)	53 (40)
Fatalities	19 (8)	2 (1)
Casualties	178 (59)	23 (13)
Block-Level		
Average Block F/EF Rating	1.39 (1.44)	0.84 (0.70)
Average Tornado Damage per Block (Millions $)	1.43 (0.60)	1.25 (0.48)

Tornadoes occur from 2002-2013. Damages in 2010$. *Electoral Competitiveness* follows Reeves [2011] and measures the 2-way voteshare of the losing political party at the mid-point of our sample (2007) averaged over 3 presidential elections (2004, 2000, and 1996). Sources: Federal Emergency Management Agency, Tornado History Project, US Census, uselectionatlas.org

Table 3: **Comparative Statistics for Individuals and Business Establishments Hit by and Near to a Tornado**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tornado Type:	Pooled		Disaster Assistance			No Disaster Assistance		
Census Block:	Hit	Nearby	Overall	Hit	Nearby	Overall	Hit	Nearby
				Panel A: CCP Variables				
Debt Balances								
Credit Card	2,467	2,763	2,636	2,411	2,732	2,925	3,216	2,887
Home	25,110	22,987	22,644	24,176	21,984	28,302	37,601	27,079
Auto	3,190	3,322	3,207	3,143	3,235	3,695	3,816	3,679
Other	1,278	1,167	1,193	1,300	1,147	1,219	989	1,249
Total	32,044	30,239	29,680	31,030	29,097	36,142	45,622	34,895
Financial Health								
Equifax Risk Score	674	675	671	672	671	696	705	695
90 Day Past Due	0.20	0.20	0.21	0.21	0.22	0.16	0.15	0.16
Foreclosure Flag	0.005	0.004	0.005	0.005	0.004	0.003	0.009	0.001
				Panel B: Census Variables				
Owner Occupied	0.77	0.74	0.75	0.77	0.75	0.74	0.87	0.72
Fraction African Amer.	0.17	0.20	0.22	0.18	0.23	0.06	0.02	0.06
Fraction Hispanic	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03
Fraction Age 65+	0.13	0.14	0.14	0.14	0.14	0.12	0.10	0.13
				Panel C: Business Establishments				
Establishments	2.2	2.2	2.0	2.1	2.0	3.1	3.0	3.1
Employees	24	27	25	23	26	33	44	31
Manufacturing Share	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
CCP Observations	5,789	15,538	17,959	5,401	12,558	3,368	388	2,980
Blocks	2,050	5,272	6,272	1,932	4,340	1,050	118	932
Establishment Blocks	5,309	12,457	15,627	4,944	10,683	2,139	365	1,774

Panel A shows CCP variable means from the quarter before a tornado. Panel B shows 2000 US Census block information. Panel C shows block-level business establishment information for the year before a tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 4: **Comparative Statistics for Individuals and Business Establishments Hit by Hit Intensity**

Census Block Hit Intensity:	(1) Low	(2) Medium	(3) High	(4) (Low - Med) SD	(5) (Med - High) SD	(6) (Low - High) SD
			Panel A: CCP Variables			
Debt Balances						
Credit Card	2,348	2,621	2,579	-0.05	0.01	-0.04
Home	26,439	25,636	19,034	0.02	0.15	0.16
Auto	3,157	3,506	2,630	-0.05	0.14	0.09
Other	1,317	1,323	1,037	0.00	0.07	0.07
Financial Health						
Equifax Risk Score	675	675	670	0.00	0.05	0.05
90 Day Past Due	0.20	0.20	0.20	0.00	0.01	0.01
Foreclosure Flag	0.006	0.007	0.000	-0.02	0.10	0.08
			Panel B: Census Variables			
Fraction Owner Occupied	0.80	0.78	0.66	0.09	0.43	0.55
Fraction African American	0.18	0.15	0.21	0.11	-0.20	-0.09
Fraction Hispanic	0.02	0.02	0.01	-0.11	0.11	0.00
Fraction Age 65+	0.13	0.14	0.16	-0.08	-0.15	-0.27
			Panel C: Business Establishments			
Number of Establishments	2.2	2.0	2.0	0.03	-0.01	0.03
Number of Employees	27	20	18	0.04	0.01	0.06
Manufacturing Employment Share	0.04	0.05	0.04	-0.03	0.06	0.03
CCP Observations	3,115	1,818	856	4,933	2,674	3,971
Number of Blocks	1,003	656	391	1,659	1,047	1,394
Number of Establishment Blocks	3,410	1,206	692	4,616	1,898	4,102

Columns 1-3 show the means of key variables separately for low, medium, and high damage blocks. Columns 4-6 calculate the standardized difference in means for the two-way comparisons between the three damage block groups. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 5: **Small Business Administration Loans Summary Statistics**

Hit ZIP Code Statistic:	Mean (Median)	Mean(Median)
Panel A: Disaster Assistance versus No Assistance		
	Assistance	**No Assistance**
Home Loans		
Total Verified Loss (1,000 $)	4,211 (701)	3,051 (170)
Total Approved Loans (1,000 $)	1,321 (266)	1,414 (132)
Per-Capita Approved Loans	297 (37)	344 (12)
Business Loans		
Total Verified Loss (1,000 $)	1,886 (68)	1,567 (0)
Total Approved Loans (1,000 $)	490 (0)	436 (0)
Per-Establishment Approved Loans ($)	3,138 (0)	2,394 (0)
Panel B: High versus Low Tornado Damage		
	F3 or Greater	**Less than F3**
Home Loans		
Total Verified Loss (1,000 $)	8,913 (3170)	1,042 (212)
Total Approved Loans (1,000 $)	2,807 (1014)	409 (80)
Per-Capita Approved Loans	649 (132)	85 (18)
Business Loans		
Total Verified Loss (1,000 $)	4,048 (352)	483 (20)
Total Approved Loans (1,000 $)	1008 (28)	163 (0)
Per-Establishment Approved Loans ($)	5,895 (300)	1,373 (0)

The SBA loan data are discussed in Manuscript Section 3.2. Sources: National Weather Service, Small Business Administration, US Census.

Table 6: **Household Finance Difference-in-Differences Estimates for Consumer Debt**

Dependent Variable:	Credit Card		Home Conditional		Auto		Other	
Tornado Type:	Aid	No-Aid	Aid	No-Aid	Aid	No-Aid	Aid	No-Aid
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Continuous Damage								
After Tornado x Hit	-59	-50	-877***	2,048***	65*	23	11	-15
	(35)	(66)	(231)	(344)	(32)	(73)	(22)	(45)
Dep. Variable Mean	2,636	2,925	61,425	71,870	3,207	3,695	1,193	1,219
R-Squared	0.012	0.001	0.015	0.033	0.004	0.000	0.021	0.002
Observations	416,242	80,466	104,078	19,524	416,242	80,466	416,242	80,466
Panel B: Binned Damage Levels								
After Tornado x Low	-34	300	-575	4,776*	65	-360	-20	184
	(79)	(181)	(1,503)	(2,409)	(121)	(352)	(72)	(135)
Dep. Variable Mean	2,287	3,161	68,614	82,372	3,148	3,280	1,362	719
After Tornado x Medium	-93	-595*	-4,013***	-2,315	186	-168	-47	-342
	(118)	(278)	(1,107)	(1,440)	(111)	(367)	(90)	(214)
Dep. Variable Mean	2,532	3,671	65,659	84,443	3,429	4,407	1,320	1,366
After Tornado x High	-407	248**	-2,697**	19,308***	333	613*	129	210***
	(278)	(98)	(1,090)	(1,597)	(199)	(300)	(80)	(62)
Dep. Variable Mean	2,611	1,957	59,365	55,090	2,527	4,606	1,033	1,117
R-Squared	0.012	0.001	0.015	0.032	0.004	0.000	0.021	0.002
Observations	416,242	80,466	104,078	19,524	416,242	80,466	416,242	80,466

This table presents difference-in-difference (DD) estimates for the four consumer debt outcomes we analyze using a triple difference model in the Manuscript (Table 3, columns 1-4). The DD estimates represent the pre- to post-tornado difference in debt outcomes for hit individuals as compared to non-hit individuals in the 1-mile tornado buffer region. The table displays DD estimates separately for aid and no-aid tornadoes. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Table 7: **Household Finance Difference-in-Differences Estimates for Financial Health**

Dependent Variable:	Equifax Risk Score		90 Day Delinquency	
Tornado Type:	Aid	No-Aid	Aid	No-Aid
	(1)	(2)	(3)	(4)
Panel A: Continuous Damage				
After Tornado x Hit	-0.1	-1.1	0.000	0.004
	(0.3)	(1.0)	(0.002)	(0.004)
Dep. Variable Mean	671.0	695.8	0.214	0.156
R-Squared	0.002	0.000	0.000	0.001
Observations	412,458	79,981	416,242	80,466
Panel B: Binned Damage Levels				
After Tornado x Low	-0.1	2.9	0.001	-0.040
	(0.8)	(3.0)	(0.006)	(0.025)
Dep. Variable Mean	672.6	703.9	0.209	0.147
After Tornado x Medium	0.7	-7.0	-0.009	0.041**
	(1.0)	(4.1)	(0.007)	(0.017)
Dep. Variable Mean	672.7	698.8	0.206	0.180
After Tornado x High	-1.7	-2.3	0.006	0.004
	(1.8)	(1.4)	(0.008)	(0.010)
Dep. Variable Mean	666.4	729.0	0.206	0.051
R-Squared	0.002	0.000	0.000	0.001
Observations	412,458	79,981	416,242	80,466

This table presents difference-in-difference (DD) estimates for the two financial health outcomes we analyze using a triple difference model in the Manuscript (Table 3, columns 5-6). The DD estimates represent the pre- to post-tornado difference in debt outcomes for hit individuals as compared to non-hit individuals in the 1-mile tornado buffer region. The table displays DD estimates separately for aid and no-aid tornadoes. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Table 8: **Difference-in-differences Estimates for Home Debt by Whether an Individual Moved Following a Tornado and by Type of Home Debt**

	Moved		Stayed		1st Mortgage Debt		Home Equity Debt	
Tornado Type:	Aid	No-Aid	Aid	No-Aid	Aid	No-Aid	Aid	No-Aid
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Continuous Damage								
After Tornado x Hit	-328	3,932***	-1,099***	1,218**	-846***	2,724***	-101*	-680***
	(775)	(1,082)	(376)	(373)	(273)	(381)	(52)	(91)
Dep. Variable Mean	$68,815	$79,041	$58,882	$69,508	$57,390	$66,521	$3,308	$4,296
R-Squared	0.011	0.014	0.012	0.040	0.013	0.031	0.006	0.006
Observations	26,661	4,850	77,417	14,674	104,078	19,524	104,078	19,524
Panel B: Binned Damage Levels								
After Tornado x Low	297	3,840	-723	5,169	-490	2,692	-154	539
	(2,771)	(4,787)	(1,409)	(2,977)	(1,368)	(3,098)	(135)	(301)
Dep. Variable Mean	$75,862	$126,117	$66,288	$72,998	$63,787	$74,295	$4,095	$7,144
After Tornado x Medium	-1,270	-7,376**	-5,436	-113	-4,202***	-1,507	-203	-497
	(2,647)	(2,716)	(1,624)	(1,537)	(1,223)	(1,673)	(183)	(1,140)
Dep. Variable Mean	$62,269	$102,202	$67,708	$77,094	$61,690	$81,450	$3,604	$3,293
After Tornado x High	-1,658	35,727***	-2,412	8,785***	-2,194*	25,817***	-504	-6,001***
	(4,183)	(3,560)	(1,749)	(1,414)	(1,246)	(1,484)	(306)	(268)
Dep. Variable Mean	$58,591	$57,428	$60,049	$53,531	$55,566	$44,964	$3,110	$10,126
R-Squared	0.011	0.011	0.011	0.040	0.013	0.029	0.006	0.006
Observations	26,661	4,850	77,417	14,674	104,078	19,524	104,078	19,524

Columns 1-2 only include individuals who move (for at least one quarter) at any point during the three years following the tornado. Columns 3-4 only include individuals who do not move. Columns 5-6 only consider mortgage debt, while columns 7-8 only consider home equity debt. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Table 9: **Triple Difference Estimates for the Number of Establishments, "1 Digit" SIC Non-manufacturing Industries**

Industry:	**Agriculture, Forestry, Fishing**	**Mining**	**Construction**	**Transportation**	**Wholesale/ Distributors**	**Retail**	**Finance, Insurance, Real Estate**	**Service**	**Public Sector**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Panel A: Continuous Model					
Cash Tornado x Post x Hit	0.004	0.000	0.021***	0.007*	-0.002	0.005	0.005	0.003	-0.006
	(0.003)	(0.001)	(0.004)	(0.004)	(0.001)	(0.010)	(0.009)	(0.014)	(0.005)
R-Squared	0.450	0.468	0.480	0.476	0.455	0.564	0.546	0.552	0.520
Observations	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743
				Panel B: Binned Model					
Cash Tornado x Post x Low	0.017	0.000	0.074	0.019	0.018	0.064*	0.045*	0.121**	0.014
	(0.011)	(0.002)	(0.045)	(0.018)	(0.013)	(0.035)	(0.023)	(0.058)	(0.010)
Cash Tornado x Post x Med	0.014**	-0.002	0.064***	0.016**	-0.020***	0.005	0.011	0.031	-0.030
	(0.006)	(0.002)	(0.016)	(0.007)	(0.007)	(0.041)	(0.013)	(0.029)	(0.025)
Cash Tornado x Post x High	-0.004	-0.002	0.038***	0.042	-0.016**	-0.006	-0.037	-0.042	-0.008
	(0.009)	(0.002)	(0.013)	(0.039)	(0.006)	(0.031)	(0.024)	(0.052)	(0.006)
R-Squared	0.450	0.468	0.481	0.476	0.456	0.564	0.546	0.552	0.520
Observations	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743

The table shows triple difference estimates for establishments in each of the "1 digit" industries that we pool together in the non-manufacturing business category (see Manuscript 6.2.2 and Table 6). Excluded from the pooled non-manufacturing category and from this table are public administration businesses (SIC 91-97) and non-classified businesses (SIC 99). Standard errors (in parentheses) are clustered by tornado. Sources: Infogroup Historical Database, National Weather Service, US Census.

Table 10: **Triple Difference Estimates for Employment, "1 Digit" SIC Non-manufacturing Industries**

Industry:	**Agriculture, Forestry, Fishing**	**Mining**	**Construction**	**Transportation**	**Wholesale/ Distributors**	**Retail**	**Finance, Insurance, Real Estate**	**Service**	**Public Sector**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Panel A: Continuous Model					
Cash Tornado x Post x Hit	0.004	-0.002	0.03***	0.032*	-0.000	0.001	0.002	0.007	-0.009
	(0.006)	(0.002)	(0.006)	(0.017)	(0.003)	(0.018)	(0.014)	(0.026)	(0.014)
R-Squared	0.464	0.429	0.487	0.485	0.456	0.555	0.534	0.545	0.510
Observations	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743
				Panel B: Binned Model					
Cash Tornado x Post x Low	0.037**	-0.003	0.136*	0.037	0.039	0.125*	0.058*	0.192*	0.027
	(0.019)	(0.008)	(0.078)	(0.028)	(0.032)	(0.067)	(0.029)	(0.097)	(0.026)
Cash Tornado x Post x Med	0.024*	-0.008	0.071***	0.047**	-0.030	-0.028	-0.006	0.099	-0.046
	(0.014)	(0.007)	(0.026)	(0.018)	(0.018)	(0.068)	(0.024)	(0.059)	(0.057)
Cash Tornado x Post x High	-0.006	-0.007	0.015	0.284	-0.022	-0.030	-0.047	-0.068	-0.006
	(0.016)	(0.006)	(0.030)	(0.232)	(0.015)	(0.064)	(0.033)	(0.211)	(0.020)
R-Squared	0.464	0.429	0.487	0.485	0.456	0.555	0.535	0.545	0.510
Observations	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743	159,743

The table shows triple difference employment estimates for establishments in each of the "1 digit" industries that we pool together in the non-manufacturing business category (see Manuscript 6.2.2 and Table 6). Excluded from the pooled non-manufacturing category and from this table are public administration businesses (SIC 91-97) and non-classified businesses (SIC 99). Standard errors (in parentheses) are clustered by tornado. Sources: Infogroup Historical Database, National Weather Service, US Census.

Table 11: **Triple Difference Estimates for Auto Purchases, and Business Establishment Sales**

Dependent Variable:	New Auto Purchases	New Auto Balance	Log(Establishment Sales)
	(1)	(2)	(3)
	Panel A: Continuous Damage		
Disaster Aid x Post x Hit	0.002	25	0.425***
	(0.002)	(30)	(0.122)
Dep. Variable Mean	0.037	$445	
R-squared	0.001	0.001	0.492
Observations	533,175	533,175	141,977
	Panel B: Binned Damage		
Disaster Aid x Post x Low	0.010**	70	0.586
	(0.004)	(61)	(0.389)
Dep. Variable Mean	0.036	$450	
Disaster Aid x Post x Medium	0.002	-11	0.520
	(0.008)	(123)	(0.328)
Dep. Variable Mean	0.039	$460	
Disaster Aid x Post x High	0.022***	329***	0.237
	(0.005)	(68)	(0.269)
Dep. Variable Mean	0.037	$395	
R-squared	0.001	0.001	0.520
Observations	533,175	533,175	141,977

The table shows triple difference estimates for new car loans, new car loan balances, and retail and service establishment sales. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 12: **Triple Difference Estimates for Auto Purchase by Credit Availability**

Dependent Variable:	**New Auto Purchases** (1)	**New Auto Balance** (2)
	Panel A: Available Credit	
Low Available Credit		
Disaster Aid x Post x Hit	0.006***	48***
	(0.001)	(17)
Dep. Variable Mean	0.019	$175
Observations	171,850	171,850
High Available Credit		
Disaster Aid x Post x Hit	0.002	13
	(0.003)	(36)
Dep. Variable Mean	0.039	$552
Observations	184,325	184,325
	Panel B: Credit Score	
Low Equifax Credit Score		
Disaster Aid x Post x Hit	0.010**	143**
	(0.005)	(68)
Dep. Variable Mean	0.029	$255
Observations	171,400	171,400
High Equifax Credit Score		
Disaster Aid x Post x Hit	0.001	-9
	(0.002)	(28)
Dep. Variable Mean	0.034	$504
Observations	170,250	170,250

The table shows triple difference heterogeneity estimates for new car loans and new car loan balances. The model is estimated separately on two groups of individuals (lower and upper terciles) based on available credit (panel A) and Equifax Risk Score (panel B). Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), National Weather Service, US Census.

Table 13: **Comparative Statistics for Individuals and Business Establishments Hit by and Near to a Tornado**

18 Tornado Balanced Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tornado Type:	Pooled		Disaster Assistance			No Disaster Assistance		
Census Block:	Hit	Nearby	Overall	Hit	Nearby	Overall	Hit	Nearby
Panel A: CCP Variables								
Debt Balances								
Credit Card	2,928	2,943	2,967	2,582	3,040	2,925	3,216	2,887
Home	34,950	26,888	27,391	31,766	26,555	28,302	37,601	27,079
Auto	3,773	3,624	3,559	3,722	3,528	3,695	3,816	3,679
Other	1,141	1,190	1,124	1,323	1,086	1,219	989	1,249
Total	42,629	34,492	35,041	39,394	34,209	36,142	45,622	34,895
Financial Health								
Equifax Risk Score	705	698	703	705	703	696	705	695
90 Day Past Due	0.15	0.16	0.16	0.16	0.16	0.16	0.15	0.16
Foreclosure Flag	0.005	0.004	0.007	0.000	0.008	0.003	0.009	0.001
Panel B: Census Variables								
Owner Occupied	0.85	0.77	0.84	0.82	0.84	0.74	0.87	0.72
Fraction African Amer.	0.02	0.04	0.01	0.02	0.01	0.06	0.02	0.06
Fraction Hispanic	0.01	0.02	0.01	0.01	0.01	0.03	0.02	0.03
Fraction Age 65+	0.11	0.13	0.14	0.13	0.14	0.12	0.10	0.13
Panel C: Business Establishments								
Establishments	2.2	2.5	2.0	1.9	2.1	3.1	3.0	3.1
Employees	32	29	27	27	28	33	44	31
Manufacturing Share	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
CCP Observations	716	4,735	2,083	328	1,755	3,368	388	2,980
Blocks	258	1,592	800	140	660	1,050	118	932
Establishment Blocks	1,370	4,670	3,901	1,005	2,896	2,139	365	1,774

Panel A shows CCP variable means from the quarter before a tornado for individuals residing in hit or nearby (control) blocks at the time of the tornado. Panel B shows 2000 US Census block group information for the same hit and nearby blocks as in Panel A. Panel C shows block-level business establishment information for the year before a tornado for the same blocks as in Panel A. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 14: **Household Finance and Migration Impact of being Hit by a Tornado**

Robustness Models

	Categories of Consumer Debt				Financial Health		Migration	
Dependent Variable:	Credit Card	Home (Conditional)	Auto	Other	Equifax Risk Score	90 Day Delinquency	1 Quarter	3 Years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Main Model								
Post x Hit	-58*	-674**	68**	7	-0.03	-0.0002	0.001	0.0012
	(33)	(281)	(30)	(21)	(0.31)	(0.0016)	(0.0014)	(0.0012)
Dep. Variable Mean	$2,467	$67,404	$3,190	$1,278	674	0.20	0.053	0.0414
R-squared	0.009	0.018	0.003	0.017	0.002	0.001	0.006	0.006
Observations	496,708	123,602	496,708	496,708	492,439	496,708	763,632	763,632
Panel B: 1-2 Mile Control Blocks								
Post x Hit	-71**	-431**	47	3	0.10	-0.0001	0.003*	0.0022*
	(33)	(206)	(29)	(20)	(0.28)	(0.0016)	(0.001)	(0.0012)
Dep. Variable Mean	$2,483	$67,197	$3,193	$1,309	674	0.20	0.055	0.0428
R-squared	0.009	0.013	0.003	0.017	0.002	0.001	0.007	0.007
Observations	566,312	145,999	566,312	566,312	561,968	566,312	924,006	924,006
Panel C: Stacked								
Post x Hit	-43	-549	67**	20	-0.03	-0.0013	0.001	0.0009
	(30)	(350)	(27)	(16)	(0.30)	(0.0018)	(0.001)	(0.0011)
Dep. Variable Mean	$2,467	$67,404	$3,190	$1,278	674	0.20	0.053	0.0414
R-squared	0.002	0.003	0.000	0.001	0.012	0.000	0.001	0.001
Observations	496,708	123,602	496,708	496,708	492,439	496,708	763,632	763,632
Panel D: Balanced Sample								
Post x Hit	-3	-164	57	8	-1.15	0.0061*	0.001	0.0000
	(48)	(1013)	(45)	(32)	(0.76)	(0.0029)	(0.002)	(0.0014)
Dep. Variable Mean	$2,928	$73,312	$3,773	$1,141	705	0.15	0.044	0.0375
R-squared	0.004	0.038	0.001	0.005	0.003	0.000	0.007	0.006
Observations	129,178	34,203	129,178	129,178	128,497	129,178	192,758	192,758
Panel E: 35 Tornado Sample								
Post x Hit	-59*	-673**	69**	6	-0.04	-0.0002	0.001	0.0012
	(33)	(280)	(30)	(21)	(0.31)	(0.0016)	(0.001)	(0.0012)
Dep. Variable Mean	$2,467	$67,270	$3,188	$1,280	674.3	0.20	0.053	0.0414
R-squared	0.009	0.018	0.003	0.017	0.002	0.001	0.006	0.006
Observations	498,731	123,868	498,731	498,731	494,436	498,731	766,357	766,357

The table estimates robustness specifications using the DiD continuous damage model. Panel A reproduces the estimates using our main model (Manuscript Table 1, panel A). Panel B estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Panel C estimates a stacked regression model (e.g. Cengiz et al. [2019]). Panel D estimates our balanced sample model that more closely matches the levels of key variables. Panel E estimates a model that includes the Wayne, NE tornado. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 15: **Household Finance and Migration Impact of being Hit by a Tornado when Federal Disaster Assistance is Available**

Robustness Models

	Categories of Consumer Debt				Financial Health		Migration	
Dependent Variable:	Credit Card	Home (Conditional)	Auto	Other	Equifax Risk Score	90 Day Delinquency	1 Quarter	3 Years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Main Model								
Disaster Aid x Post x Hit	-39	-2,179***	42	7	1.3	-0.0051	0.004**	0.0036**
	(81)	(574)	(71)	(52)	(0.9)	(0.0035)	(0.002)	(0.0014)
Dep. Variable Mean	$2,411	$66,371	$3,143	$1,300	672	0.2073	0.054	0.0421
R-squared	0.009	0.017	0.003	0.017	0.001	0.000	0.005	0.002
Observations	496,708	123,602	496,708	496,708	492,439	496,708	763,632	763,632
Panel B: 1-2 Mile Control Blocks								
Disaster Aid x Post x Hit	-47	-1,453**	11	-38	1.2	-0.0019	0.006***	0.0064***
	(87)	(594)	(62)	(61)	(0.7)	(0.0035)	(0.002)	(0.0013)
Dep. Variable Mean	$2,430	$66,058	$3,146	$1,332	672	0.2064	0.056	0.0432
R-squared	0.009	0.013	0.003	0.017	0.002	0.000	0.005	0.004
Observations	566,312	145,999	566,312	566,312	561,968	566,312	924,006	924,006
Panel C: Stacked								
Disaster Aid x Post x Hit	16	-3,884***	-125	-4	1.0	-0.0048	0.002	0.0013
	(71)	(357)	(74)	(57)	(1.0)	(0.0031)	(0.001)	(0.0003)
Dep. Variable Mean	$2,411	$66,371	$3,143	$1,300	672	0.2073	0.054	0.0421
R-squared	0.000	0.000	0.000	0.001	0.012	0.000	0.001	0.001
Observations	496,708	123,602	496,708	496,708	492,439	496,708	763,632	763,632
Panel D: Balanced Sample								
Disaster Aid x Post x Hit	40	-3,228***	60	41	-0.1	0.0043	0.006**	0.0044*
	(96)	(637)	(87)	(61)	(1.3)	(0.0055)	(0.003)	(0.0013)
Dep. Variable Mean	$2,582	$66,661	$3,722	$1,323	705	0.1565	0.044	0.0429
R-squared	0.004	0.037	0.001	0.005	0.003	0.000	0.005	0.004
Observations	129,178	34,203	129,178	129,178	128,497	129,178	192,758	192,758
Panel E: 35 Tornado Sample								
Disaster Aid x Post x Hit	-22	-2,186***	20	31	1.3	-0.0052	0.004**	0.0036**
	(92)	(576)	(76)	(48)	(0.9)	(0.0035)	(0.002)	(0.0014)
Dep. Variable Mean	$2,411	$66,371	$3,143	$1,300	672	0.2073	0.054	0.0421
R-squared	0.009	0.018	0.003	0.017	0.001	0.000	0.005	0.002
Observations	498,731	123,868	498,731	498,731	494,436	498,731	766,357	766,357

The table estimates robustness specifications using the triple difference continuous damage model. Panel A reproduces the estimates using our main model (Manuscript Table 3, panel A). Panel B estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Panel C estimates a stacked regression model (e.g. Cengiz et al. [2019]). Panel D estimates our balanced sample model that more closely matches the levels of key variables. Panel E estimates a model that includes the Wayne, NE tornado. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.

Table 16: **Business Establishment Survival Robustness Specifications**

Dependent Variable:	Main Model	with 1 to 2 mile control	Stacked	Balanced Sample	35 Tornadoes
	(1)	(2)	(3)	(4)	(5)
		Panel A: Difference-in-Difference			
Post x Hit	-0.016***	-0.012***	-0.016***	-0.018*	-0.016***
	(0.005)	(0.005)	(0.005)	(0.009)	(0.005)
R-squared	0.539	0.532	0.579	0.504	0.539
Observations	159,743	139,451	159,743	54,209	161,273
		Panel B: Triple Difference			
Disaster Assistance x Post x Hit	0.050**	0.058**	0.050**	0.044	0.016
	(0.023)	(0.028)	(0.023)	(0.028)	(0.035)
R-squared	0.551	0.542	0.575	0.529	0.551
Observations	159,743	139,451	159,743	54,209	161,273

The table estimates robustness specifications using the continuous damage model with ln(business establishments) as the dependent variable. Panel A estimates the DiD model, while panel B estimates the triple difference model. Column 1 reproduces the estimates using our main models (Manuscript Table 2, panel A, column 1; Manuscript Table 5, panel A, column 1). Column 2 estimates our main model, except that we use control blocks from the buffer area 1-2 miles from the edge of the tornado (rather than 0.5-1.5 miles). Column 3 estimates a stacked regression model (e.g. Cengiz et al. [2019]). Column 4 estimates our balanced sample model that more closely matches the levels of key variables. Column 5 estimates a model that includes the Wayne, NE tornado. Standard errors (in parentheses) are clustered by tornado. Sources: Federal Reserve Bank of New York Consumer Credit Panel / Equifax (CCP), Infogroup Historic Business Database, National Weather Service, US Census.