Global Economic Insight

Harnessing big data for natural disaster recovery and planning

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After a wildfire, flood, earthquake or other disaster strikes, the ruins left behind provide a visual reminder of a community's physical losses. In contrast, visualizing the economic losses from natural disasters goes beyond what can be seen by the naked eye. Restoring a community's built infrastructure is a necessary first step, but what about the social interactions, including commerce, that often define a community? This is where big data can help to recall what was lost, assess what remains and help in building back stronger and more resilient communities.

Cutting-edge geospatial analysis combined with anonymized VisaNet transactions can provide data and insights to assist in rebuilding economies following disasters. For this report, **Visa Business and Economic Insights** (VBEI) analyzed payments data for two recent disasters: Storm Boris in September 2024 in Central Europe and the Eaton and Palisades fires that swept through Los Angeles, Calif. in January of this year. Beyond looking at individual events, we also leveraged our proprietary **Spending Momentum Index**—combined with publicly available county-level data—to compare multiple natural disasters over time and better understand how big data can help unlock new ways to anticipate the potential challenges and needs of future crises. In the wake of natural disasters, big data can play a large role in helping communities and governments both measure the economic impact of an event and identify opportunities to better allocate resources to speed recovery in their rebuilding efforts.

Key Points:

- Data can assist economic recovery after natural disasters
- While all disasters can leave a mark on local economies, floods in particular have much deeper and longer-lasting impacts on spending

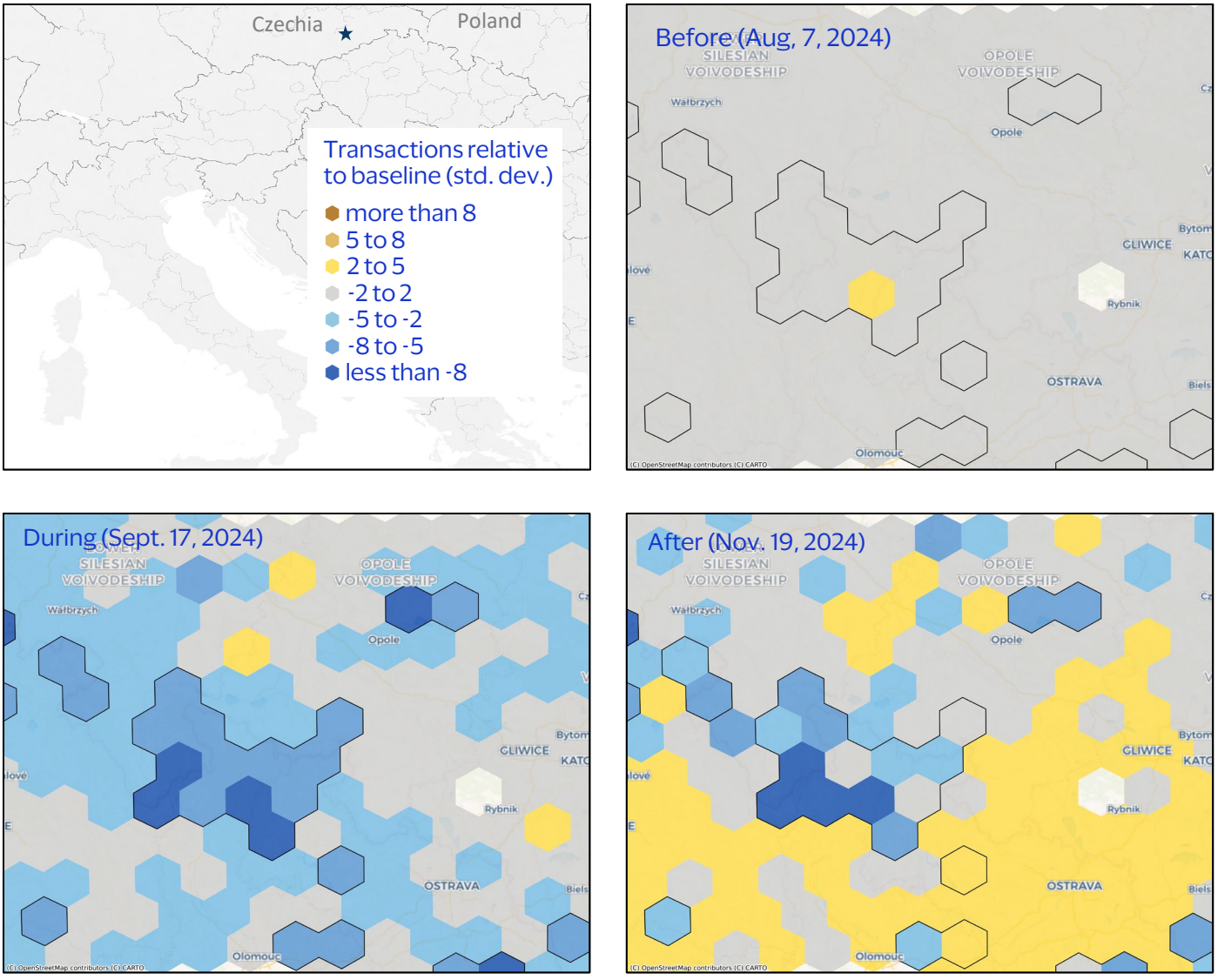
Modeling spending and supply chains post-flooding

VBEI's comparison of multiple disasters over time found significant variances in short term and longer-term impacts depending on the type of disaster, with floods taking a deeper toll on both consumer and merchant activity post-event. As part of this study, we analyzed aggregated transaction data for areas in Czechia and Poland that flooded during Storm Boris in September 2024. Using transaction counts, which better capture the impact of flooding on supply chains, we were able to visually reconstruct what the region's economy looked like immediately prior, during and two months after the floods (Fig. 1).

The maps show that the floods impacted a wide swath of the region. In the areas with the worst flooding (outlined in black), consumer spending dropped by 47 percent relative to the projected baseline absent flooding. Two months after the floods had receded, much of the region's economy was on the path to recovery, as denoted by the large areas shaded in yellow. The areas with more substantial damage, however, remained well below their baseline. Both the number of consumers and active merchants in these areas were still half of what they were prior to the floods.

Fig. 1: Spending impact of the September 2024 floods in Central Europe

Change in transactions relative to baseline scenario for the week ending on the specified dates



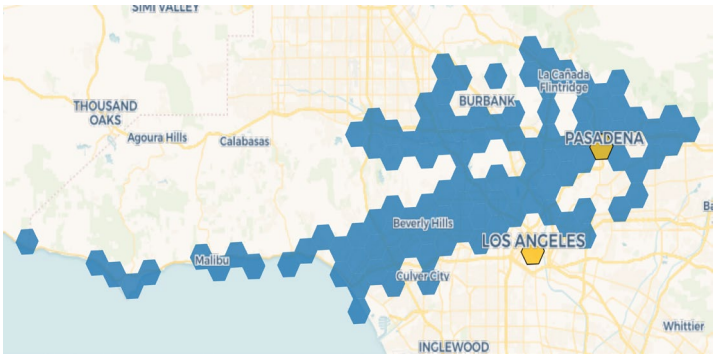
Source: Visa Business and Economic Insights analysis of VisaNet data

Applying big data to analyze the L.A. wildfires

VBEI further explored how VisaNet transaction data could be useful at each stage of the recovery process for a more recent disaster: the Eaton and Palisades fires that swept through Los Angeles, Calif. in January of this year. The first step in the process of using data to help measure the impact of the damage and scope for recovery was to create a baseline of commerce in the area. Better than a snapshot, this baseline serves as an outline of spending that could have occurred in the region absent the wildfires.

To do this, we created a model based on VisaNet transaction data and a geospatial indexing system that divided Los Angeles into geographic cells. Each cell was assigned a predictive series to show what commerce would have looked like if the fire hadn't happened (more details below). While the fires burned 37,830 acres[1]— about the size of San Francisco—the initial economic impact from the wildfires was even more widespread. Our analysis indicates the wildfires lowered spending and disrupted commerce in communities spanning over 218,240 acres, as represented in the shaded areas on the map (Fig. 2).

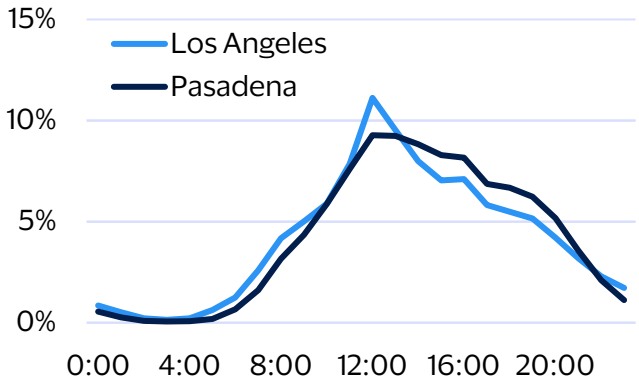
Fig. 2: Areas with economic impact from the fires



Areas impacted by the fires
Areas used in comparative analysis in fig. 3

Fig. 3: Purchases in downtown L.A. indicate more spend on morning coffees and lunchtime rush

Card transactions by hour (share of total per weekday)



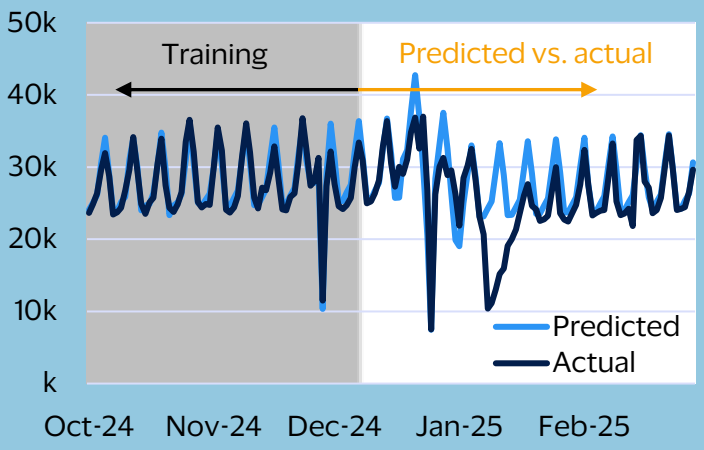
The data also helped to recall the flow of commerce within the impacted areas. Comparing the distribution of spending across a weekday[2] in downtown Pasadena as compared to downtown L.A. revealed important differences between the two areas. First, a greater share of transactions in downtown L.A. occurred in the morning and fewer in the evenings, suggesting that most sales took place during regular working hours. The reverse was true for Pasadena, indicating that most residents commuted out of the area for work. This inference is reinforced by the pronounced spike in spending around lunchtime in downtown L.A., which is not present in the impacted areas (Fig. 3).

The making of the model

Los Angeles was divided into hexagonal cells using a global geospatial indexing system called H3. For each cell, such as the one around downtown Pasadena, a synthetic series was created to show what commerce would have looked like if not for the fire (Fig. 4). To create the predicted—or synthetic—series, we trained our model on two-and-half years of data up to November 2024 and included weekly seasonality and calendar-based factors, such as the timing of the Christmas holidays. The fires occurred during the post-holiday period when commercial activity in the area ordinarily decreases. Spending in areas of Pasadena that weren't burned was as depressed as areas directly in the fire's path, and remained so for at least two weeks after the fire had been fully contained at the end of January.

Fig. 4: Establishing the baseline: downtown Pasadena

Card transactions relative to scenario without the wildfires



Source for fig. 2-4: Visa Business and Economic Insights analysis of VisaNet data

Monitoring and measuring impact with data insights

With the baseline now established, the data from the first week (Jan. 8–14, 2025) when the wildfires swept through the area shows three impacts. First, commerce in impacted areas collapsed due to the dangers presented by the fires (Fig. 5). Areas in the Pacific Palisades and Altadena adjacent to the fire zone saw transaction counts fall by more than eight standard deviations away from what would have been expected if not for the wildfires.

Legend for figures 5–7

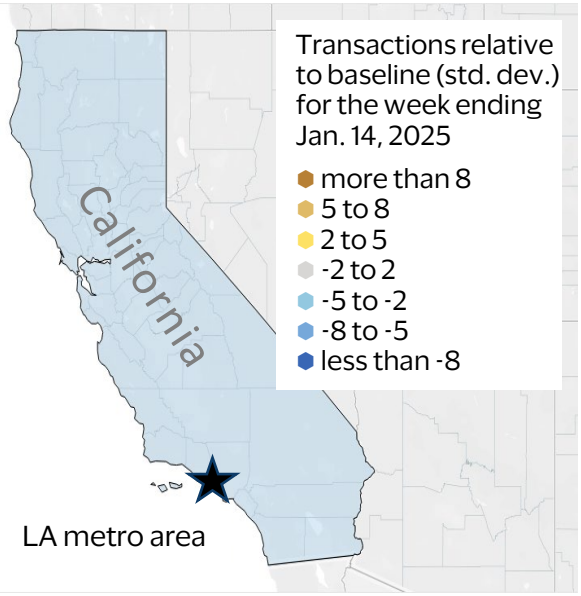


Fig 5. Spending in areas impacted by the fires

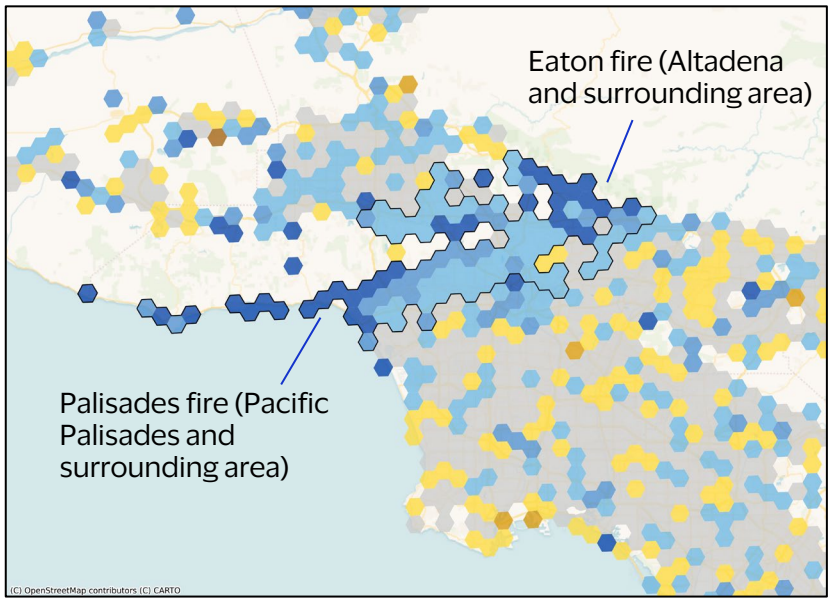


Fig . 6: Residents shifted their purchases over a wide area

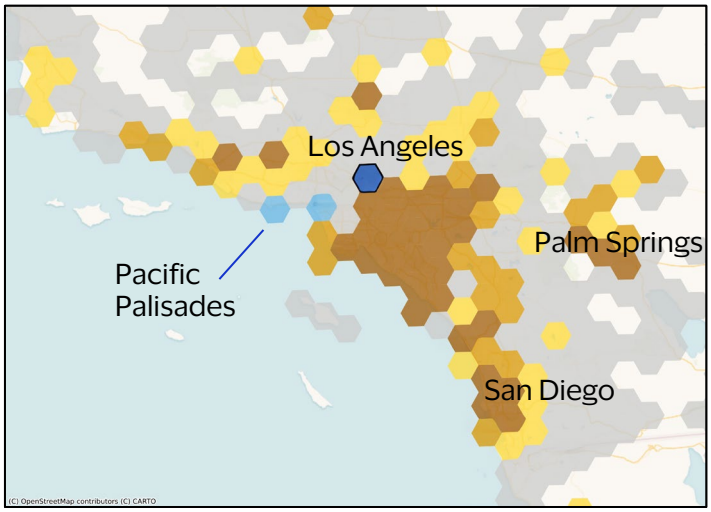
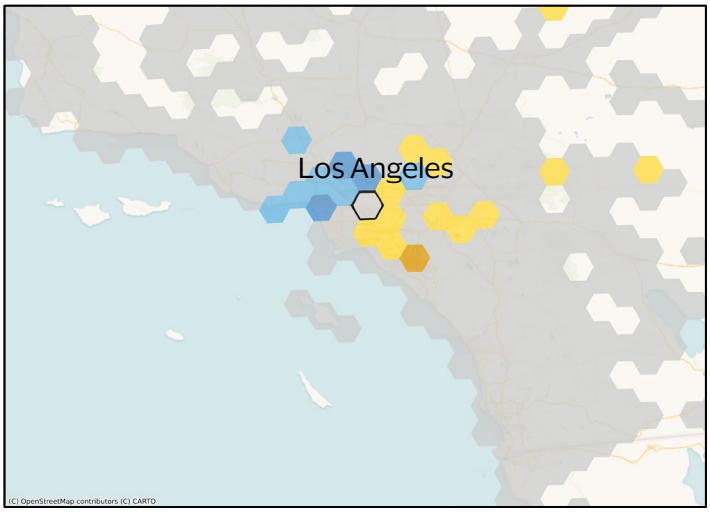


Fig . 7: Non-residents spent closer to home



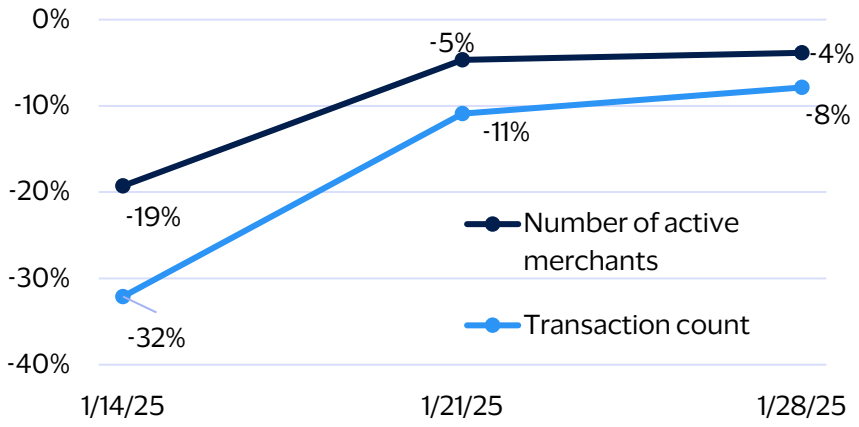
Second, the fires displaced residents and the spending they would otherwise have done in the affected areas (Fig. 6). Residents moved as far away as San Diego and Palm Springs—around 2–3 hours by car from the impacted areas, as shown by their spending, which increased by eight standard deviations above what would have been expected based on their established spending patterns prior to the disaster.

Lastly, would-be shoppers from neighboring areas shifted spending from the impacted areas to nearer to home (Fig. 7). The shift only partially offset the fall in spending for communities impacted by the fire, but commerce did not completely grind to a halt either, according to the data. Four out of five businesses continued to operate, and sales within the fire-impacted region dropped by less than a third.

Data for resilience and disaster planning

The resilience after the L.A. wildfires provides reason to hope that, with help from big data, commerce can resume faster once the immediate threat has passed. As the data shows, recovery took hold soon after the fires were suppressed: Two weeks after the fires were out, consumer spending had mostly bounced back, down only 8 percent from its pre-disaster trend (Fig. 8). With the recovery in spending lagging the reopening of businesses, we know that the loss of customers could constrain the initial rebuilding of communities in the burned areas. Until rebuilding happens, businesses still operating within the affected areas after the disaster could be left struggling to sustain their businesses amid reduced sales.

Fig. 8: Commercial recovery takes hold after the L.A. fires
Transactions relative to scenario where wildfires had not occurred

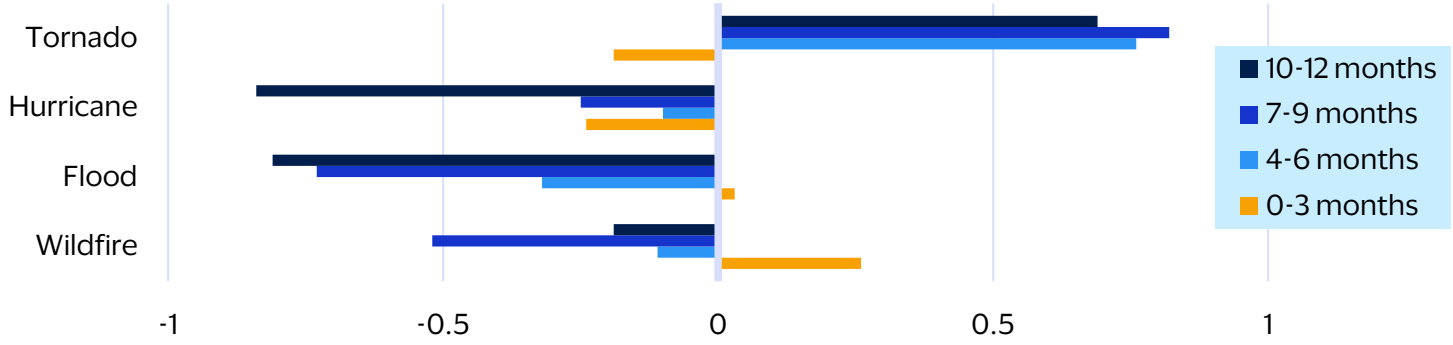


Source: Visa Business and Economic Insights analysis of VisaNet data

Beyond the value that big data brings to individual events, it can also unlock new ways to anticipate the potential challenges and needs of future crises by comparing multiple natural disasters over time. VBEI studied this by combining data from the Visa Spending Momentum Index (SMI), a consistent measure of consumer demand across U.S. counties, with data on disasters that led to at least $250 million in county-level losses from 2008–2023 as compiled by the Federal Reserve Bank of New York.[3] The effect on spending is estimated by comparing the SMI in disaster-impacted counties relative to neighboring counties within the state during the same time period.

The data shows that natural disasters lead to a temporary boost in consumer activity that lasts 8–9 months after a major disaster, but with some payback thereafter as spending normalizes in the disaster's aftermath (Fig. 9). Displaced residents must seek temporary housing, while those who remain increase their home improvement purchases to repair disaster-related damage, both of which lift discretionary spending. In contrast, normal everyday spending suffers, as those who are displaced tend to spend more on restaurants than groceries. Gasoline purchases are an additional early boost, with those fleeing the area fueling up their vehicles for longer drives.

Fig. 9: Impact of natural disasters by type on consumer demand
Difference between impacted and other U.S. counties' SMIs



Source: Visa Business and Economic Insights analysis of the Visa SMI

Additional resources available from Visa following a natural disaster

Information provided by Visa through its Back to Business Locator Tool can help identify businesses that have survived a crisis. In some cases, digital payments can also play a role in sustaining demand in the face of tragedy.[4] For example, Visa has partnered with Oxfam to scale its Building Resilient, Adaptive and Disaster-Ready Communities (B-Ready) to deliver real-time, streamlined money movement and relief payments to individuals and businesses in the Philippines, Kenya, Colombia and Puerto Rico.[5]

Footnotes

1. Doug C. Morton and Cindy Starr, "Spread of the Palisades and Eaton Fires – January 2025," Friday July 11, 2025, NASA Scientific Visualization Studio. NASA SVS | Spread of the Palisades and Eaton Fires - January 2025
2. Weekdays for the purposes of this analysis are defined as starting at 5:00 p.m. on Sunday and running through 5:00 p.m. on Friday.
3. Federal Reserve Bank of New York, Losses from Natural Disasters https://newyorkfed.org/research/policy/natural-disaster-losses/.
4. Local Business Directory – Find Local Businesses to Support | Visa
5. Visa and Oxfam America to Explore Expanding Anticipatory Action Program to Bring Pre-Disaster Financial Support to the Philippines, Kenya, Colombia, and Puerto Rico | Visa

Accessibility notes

Fig. 1: Three geospatial heatmaps showing changes in transaction activity in a flood-affected area near Ostrava, Czechia before, during, and after Storm Boris. Transaction levels are categorized by standard deviation ranges.
- Areas outlined in black experienced the worst flooding.
- During the week ending August 7, 2024, consumer spending dropped by 47% compared to the baseline.
- During the week ending Sept. 17, yellow-shaded areas indicate partial recovery, but the most damaged regions still had only half the number of consumers and merchants compared to pre-flood levels.

Fig. 2: A geospatial map of Los Angeles shows shaded hexagonal cells representing areas affected by the Eaton and Palisades wildfires. Each cell contains a synthetic prediction of commerce levels had the fires not occurred. The map shows that the fires burned 37,830 acres, but economic disruption extended to over 218,240 acres.

Fig. 3: A line chart comparing weekday transaction shares by hour in downtown L.A. and Pasadena.
- For Los Angeles, morning peak begins around 8 a.m.
- The highest transaction share occurs around noon.
- Transactions decline in the evening.
- For Pasadena, activity is low in the morning and transactions are more prominent in the afternoon.

Fig. 4: A line chart compares actual consumer spending in Pasadena to a synthetic series predicting what spending would have looked like without the wildfires. The graph shows a sharp decline in actual spending during the week of the fires.

Fig. 5: A geospatial heatmap showing spending impacts of the Eaton and Pacific Palisades fires on the L.A. area for the week ending Jan. 14, 2025. A map of the state of California is also shown for context.
- Transaction levels are categorized by standard deviation ranges.
- In the areas around the Pacific Palisades and Altadena neighborhoods, spending dropped by over 8 standard deviations below baseline.

Fig. 6: A geospatial heatmap showing spending impacts of the L.A. wildfires on the greater L.A. area for the week ending Jan. 14, 2025.
- Transaction levels are categorized by standard deviation ranges.
- In distant areas like San Diego and Palm Springs, spending increased by over 8 standard deviations above baseline.

Fig. 7: A geospatial heatmap showing spending impacts of the L.A. wildfires on the greater L.A. area for the week ending Jan. 14, 2025.
- Transaction levels are categorized by standard deviation ranges.
- Spending increased or stayed the same in unaffected neighboring areas.

Fig. 8: A line chart shows the recovery in consumer spending over the two-week period following the L.A. fires.
- Compared to the pre-disaster trend, the average transaction count rose from -32% on Jan. 14 to -8% by Jan. 28.
- Active merchants in the area rose from -19% on Jan. 14 to -4% on Jan. 28.

Fig. 9: A bar chart displays the difference in consumer demand, measured by the change in SMI, across four types of natural disasters—wildfires, floods, hurricanes, and tornadoes—and over the following time intervals after the disaster: 0–3 months, 4–6 months, 7–9 months, and 10–12 months.
- Wildfire: +0.26 (0–3 months), then declines -0.52 (7–9 months)
- Flood: +0.03 (0–3 months), drops -0.81 (10–12 months)
- Hurricane: -0.24 (0–3 months), -0.84 (10–12 months)
- Tornado: -0.19 (0–3 months), rises +0.82 (7–9 months)

Forward Looking Statements

This report may contain forward-looking statements within the meaning of the U.S. Private Securities Litigation Reform Act of 1995. These statements are generally identified by words such as "outlook", "forecast", "projected", "could", "expects", "will" and other similar expressions. Examples of such forward-looking statements include, but are not limited to, statements we make about Visa's business, economic outlooks, population expansion and analyses. All statements other than statements of historical fact could be forward-looking statements, which speak only as of the date they are made, are not guarantees of future performance and are subject to certain risks, uncertainties and other factors, many of which are beyond our control and are difficult to predict. We describe risks and uncertainties that could cause actual results to differ materially from those expressed in, or implied by, any of these forward-looking statements in our filings with the SEC. Except as required by law, we do not intend to update or revise any forward-looking statements as a result of new information, future events or otherwise.

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