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### Title

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# A Detailed Look at How the Pandemic Changed Travel Patterns Across Regions in Northern California Megaregion

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## Issue

Many studies have focused on the shifts in travel patterns caused by the COVID-19 pandemic and how travel demand continues to evolve in the post-pandemic era. Key metrics such as trip volume—the total number of trips within a specific area—help explain the pandemic’s impact on travel demand over time. However, to fully understand changes in travel behaviors, it is also important to analyze where trips start and end—otherwise known as Origin-Destination (OD) demand.

To better understand OD demand during and after the pandemic, our research team developed a data-driven methodology to analyze travel patterns across different regions, times of day, days of the week (weekday and weekend), and trip purpose. This study used passively collected location-based data<sup>1</sup> from the StreetLight Data platform (StreetLight Data, 2022)<sup>2</sup> in the form of weekly OD matrices of all vehicle modes, segmented by various relevant variables. We focused on the Northern California Megaregion, which includes 21 counties from the San Francisco Bay Area to the Sacramento region and the northern part of the San Joaquin Central Valley. The study period spanned from January 2019 to October 2021.

## Key Research Findings

**Total weekday trip volumes dropped nearly 50% by April 2020 but recovered to pre-pandemic levels by October 2021.** In the second week of January 2019, the Northern California Megaregion saw an estimated 30.3 million

average daily trips made on weekdays. In the first week of April 2020, the average daily trip volume plummeted by 47%. Average daily home-based work trips dropped by 37%, daily home-based other trips by 46%, and daily non-home-based trips by 56% on weekdays. By October 2021, daily trip volumes had almost returned to pre-pandemic levels, with the average daily weekday trip volumes just 8% below the same week in October 2019.

**Non-home-based trips experienced the greatest disruption and are lagging in recovery.** Non-home-based trips represent trips—those that neither start nor end at home (e.g., trips from the workplace to a grocery store)—were the most disrupted during the pandemic and are recovering more slowly than other trip types. In January 2019, there were 10.1 million average daily non-home-based trips on weekdays and 8.2 million on weekends. By April 2020, these volumes dropped by 56% on weekdays and 66% weekends. Compared to other trip types, non-home-based trips began to recover at a slower rate, likely due to a combination of factors, including people reducing or eliminating stops during commutes (e.g., grocery store visits, coffee shop stops) and the increase in hybrid and fully remote work, which further reduced the number of commuting trips.

**Location-based data provides empirical evidence of variations in the disruption and recovery of OD travel demand by region, time of the day, day of the week, and trip purpose.** Our results demonstrate that the impact of the pandemic on travel demand was not uniform, including by region, time of the day, day of the week, and trip purpose.

Using location-based data can help identify spatial and temporal travel patterns, which is valuable for allocating transportation planning resources more effectively at the local and regional level. This data can also inform future pandemic preparation guidelines by highlighting which types of trips are most sensitive to disruptions and how different types of corridors may be impacted based on commuting patterns versus other travel behaviors.

**OD demand for home-based trips saw the largest disruption, especially during the peak AM period (6 AM to 10 AM) on weekdays.** The peak AM period in January 2019 accounted for an average of 2.3 million daily home-based work trips. This period experienced significant disruption during the pandemic, which varied both spatially and temporally across California. Regions with a high proportion of white-collar jobs, such as the San Francisco Bay Area, saw the greatest declines in home-based work trips, which rebounded more slowly as remote work persisted. In contrast, rural areas with a higher concentration of blue-collar jobs—where remote work options were limited—experienced smaller disruptions and a faster recovery.

**Disruption and recovery patterns of home-based other trips varied significantly, especially during the late PM to early AM (7 PM to 6 AM).** Home-based other trips (i.e., non-work trips that start or end at home) also experienced considerable disruption during the pandemic, particularly in the late PM and early AM hours. Although this period represents 11 hours, it accounted for just 20% of all home-based other trips in January 2019. This disruption was likely linked to pandemic-related restrictions, such as “stay-at-home” orders and business closures, as well as concerns about exposure to COVID-19. However, regional variations in the disruption and recovery of these trips were notable.

**Socioeconomic factors likely influenced the degree of disruption and recovery.** The San Francisco Bay area, with a higher concentration of higher-income, white-collar jobs, experienced the most disruption and slower recovery. Conversely, the Northern San Joaquin Valley, with a higher concentration of blue-collar workers, experienced less disruption and a quicker recovery. The Sacramento and Monterey Bay areas experienced more intermittent disruptions, with recovery patterns that fell somewhere in between.

## Policy Implications

Our results demonstrate that the impact of the pandemic on travel demand was not uniform, including by region, time of the day, day of the week, and trip purpose. Using location-based data can help identify spatial and temporal travel patterns, which is valuable for allocating transportation planning resources more effectively at the local and regional level. This data can also inform future pandemic preparation guidelines by highlighting which types of trips are most sensitive to disruptions and how different types of corridors may be impacted based on commuting patterns versus other travel behaviors.

## More Information

This policy brief is drawn from the article “Investigating Travel Demand Heterogeneity During and After the Pandemic in the Northern California Megaregion: A Data-Driven Analysis of Origin-Destination Structural Patterns” available at [www.ucits.org/research-project/2022-07](http://www.ucits.org/research-project/2022-07). For more information about the findings presented in this brief, please contact Giovanni Circella at [gcircella@ucdavis.edu](mailto:gcircella@ucdavis.edu) and Siddhartha Gulhare at [sgulhare@ucdavis.edu](mailto:sgulhare@ucdavis.edu).

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<sup>1</sup>Passively collected data is automatically gathered from devices like GPS, cell phones, or connected systems.

<sup>2</sup>StreetLight Data, I., 2022. Streetlight Data. [Online] Available at: <https://www.streetlightdata.com/> [Accessed Nov 2022].

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