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TRANSPORT FINDINGS

Examining Pre- and Post-Pandemic Cross-Border Trips Using Crowdsourced Data at the Second-Busiest US-Mexico Border Community

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Findings

The US-Mexico border witnesses frequent cross-border travels for educational, recreational, healthcare, and work purposes, with millions of passenger and commercial vehicles crossing the international border each year. In 2020, pandemic-related travel restrictions were applied to non-US citizens at the US-Mexico border and reshaped cross-border trips. Using crowdsourced data, we explored the mobility changes that the COVID-19 pandemic brought to the second-busiest border region between the United States and Mexico. Results showed that although some patterns remained similar, overall mobility decreased significantly.

1. Questions

The El Paso–Ciudad Juárez region has long functioned as one binational metropolitan area divided by a border but united by land ports of entry. The border has been the second-busiest border between the United States and Mexico, with almost 30 million people and 12 million vehicles crossing from Juárez, Mexico, to El Paso, Texas, in 2019 (Bureau of Transportation Statistics 2022). Cross-border mobility, however, suffered an abrupt change on March 21, 2020, 10 days after the World Health Organization (WHO) declared COVID-19 a pandemic (WHO, 2020). After a mutual agreement between the US and Mexican governments, northbound entries were temporarily restricted to essential travelers or US citizens/residents (US Customs and Border Protection 2020). These restrictions significantly affected and reshaped cross-border mobility, leading to this study's two initial research questions: (1) How much did the travel restrictions affect cross-border trips in terms of volume and trip purpose? (2) How did volume variations impact the cross-border mobility patterns?

Data that depict activity related to the origin-destination of cross-border trips have traditionally been limited to a few sources and gathered mainly from traditional surveys. However, "advancements in technologies and the proliferation of smartphones have created new data sources that can help eliminate limitations related to small sample size and infrequent updates due to limited resources" (Lee and Sener 2020). Crowdsourced data sources in particular might be beneficial for addressing the unique limitations to capturing cross-border trip data—such as those related to scarce resources and complications arising from the involvement of international jurisdictions. Thus, we conducted a cross-border mobility analysis using location-based

crowdsourced data, which led to the emergence of a third research question: What is the potential of crowdsourced data sources for exploring cross-border trips?

2. Methods

The primary data used in this study were obtained from INRIX, which collects detailed trip information on a continuous time-space spectrum utilizing location-based data through mobile phones and connected vehicles (INRIX, n.d.). INRIX data provide many attributes for each trip registered, including the origin and destination coordinates. To capture the effect of the pandemic, pre- and post-travel restriction data were used. The pre-restriction data (October–November 2019, and Jan 20–March 19, 2020) demonstrated a typical traffic flow between the El Paso–Ciudad Juárez border cities, while post-restriction data (March 20–April 19, 2020) captured the initial period of border restrictions. In other words, we explored four months of pre-pandemic data (from two different periods) and one month of data following the border travel restrictions.

We conducted extensive data cleaning processes to prepare the data for analysis (see Vargas et al. 2021 for details). In brief, to identify northbound (southbound) cross-border trips, we filtered the trips with origins in Mexico (United States) and destinations in the United States (Mexico). Trips with origins or destinations at the border were removed since INRIX identifies a trip as ended when no movement greater than 100 meters in 10 minutes is detected (Montero and Ros-Roca 2020). This procedure can be problematic in the context of cross-border trips (e.g., crossing time could take more than two hours due to border wait times). Finally, we segregated trips based on attributes from INRIX. Trip purposes were also identified for northbound trips—for which Point of Interest (POI) data from SafeGraph (n.d.) land use data were available—by linking the destination to the closest land use by parcel and POI within 200 ft (~61 meters). We analyzed the data through an exploratory approach, including an extensive descriptive exploration of patterns in trips crossing the border, with a focus on vehicle type, trip time (month, day of week, and time of day), trip distance, and trip purpose.

3. Findings

For the study period, 94,336 northbound and 153,435 southbound cross-border trips were registered. Figure 1 demonstrates the trip volume distribution by period. While monthly trip rates were similar during the pre-pandemic period, COVID-19 impacted border traffic drastically, with a significant reduction after border restrictions were implemented. Regardless of the direction of travel, cross-border trip volume was reduced by more than 50 percent compared to the pre-pandemic months of the study period. In addition to the cross-border travel restrictions, other policies that reduced the number of trips included business and recreational area closures, social

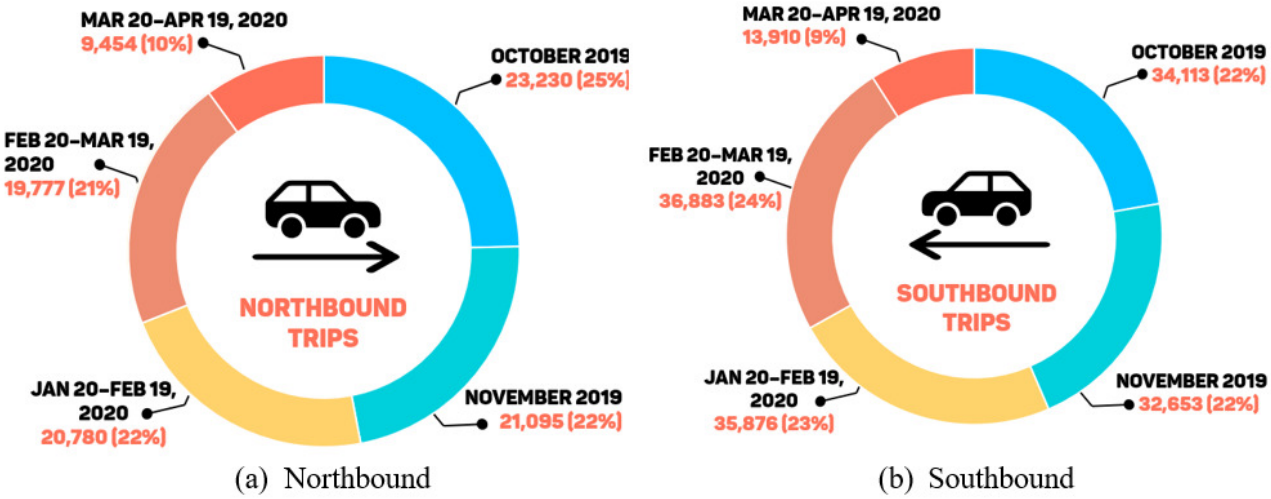

Figure 1. Monthly cross-border trips

distancing practices, and stay-at-home orders proposed by both country governments—potentially resulting in the lowest trip volume in 2020 (see also Gurbuz, Aldrete, and Vargas 2020).

Table 1 provides the cross-border trip distribution by vehicle type by period. Expectedly, passenger vehicles were by far the most common vehicle type in both directions, with more than 90 percent of the cross-border trips being passenger vehicles. This finding is consistent with the data provided by BTS (2020), which reported that 93 percent of the total crossings were passenger vehicles and 7 percent were commercial vehicles. Commercial vehicles were also affected during the first month after the pandemic declaration. While the reduction in both types of vehicles can be considered extreme, the passenger vehicles observed a higher reduction, probably because trips made by commercial vehicles were considered essential travel. Similar results were obtained by Maoh and Anderson (2021) in terms of reduced rates in truck movement across the U.S.-Canada border-crossings. The reduction in commercial traffic can be attributed to the closure of manufacturing plants in Mexico since only essential manufacturing plants could operate at the time, thereby reducing the export volume to the United States from Mexico.

Figure 2 and Figure 3 provide the cross-border trip volume by day of the week for northbound and southbound directions, respectively. The findings indicated higher traffic volume on weekdays versus weekends for northbound trips. In contrast, Fridays and Saturdays saw the highest trip volume for southbound trips. Regardless of the trip direction, Sunday had the lowest trip volume. A similar trend was observed for pandemic data (though with a lower volume), indicating that travel restrictions did not affect the overall pattern.

Table 2 shows the number of monthly trips for various industry categories, excluding the categories that captured less than 160 monthly trips. Although substantial reductions were observed after border travel restrictions, a similar travel pattern occurred before and after restrictions, with residential, retail

Table 1. Vehicle type for cross-border trips

Period	Date Range	Northbound				Southbound			
		Passenger Vehicles		Commercial Vehicles		Passenger Vehicles		Commercial Vehicles	
		Value	%	Value	%	Value	%	Value	%
Before travel restrictions	Oct 2019	21,478	92%	1,752	8%	31,660	93%	2,453	7%
	Nov 2019	19,520	93%	1,575	7%	30,259	93%	2,394	7%
	Jan 20–Feb 19, 2020	19,586	94%	1,194	6%	33,162	92%	2,714	8%
	Feb 20–Mar 19, 2020	18,667	94%	1,110	6%	34,418	93%	2,465	7%
	Monthly average	19,813	93%	1,408	7%	32,375	93%	2,507	7%
After travel restrictions	Mar 20–Apr 19, 2020	8,621	91%	833	9%	12,218	88%	1,692	12%
	Monthly percent reduction	56%		41%		62%		32%	
Total		87,872	93%	6,464	7%	141,717	92%	11,718	8%

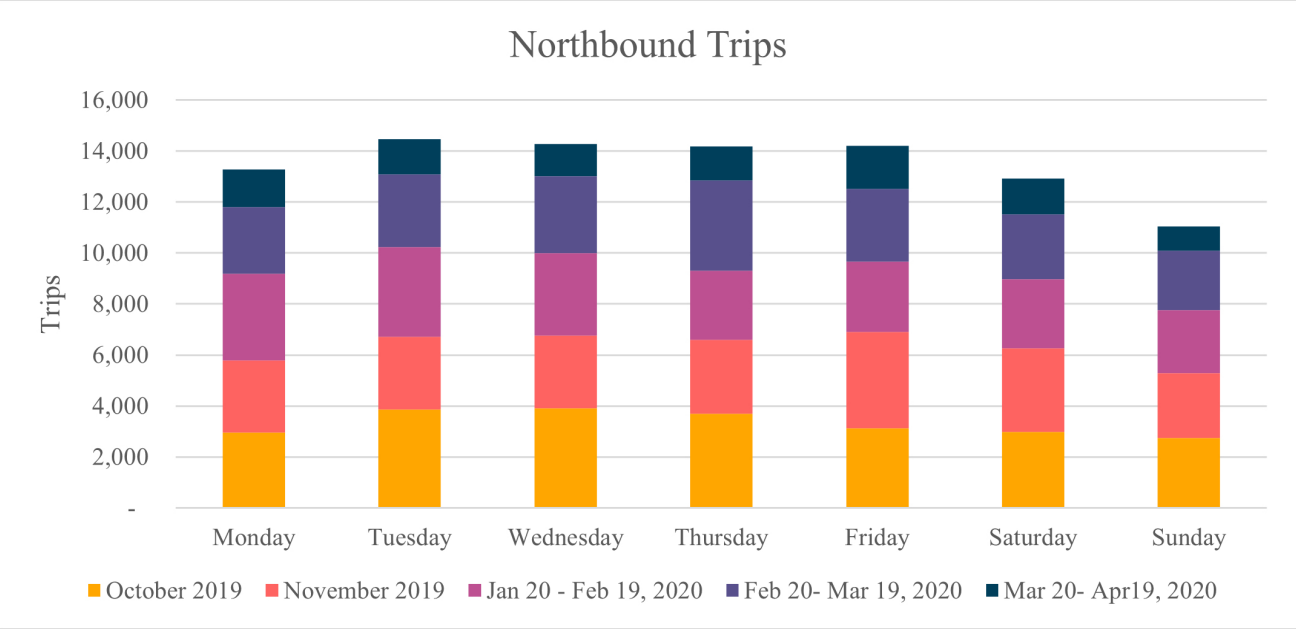

Figure 2. Northbound cross-border trip volume by day of the week

trade, and food services trips being significant in both periods. Among all categories, finance and insurance trips were affected the least, with a 44 percent average monthly trip reduction. Although recreational trips did not appear in the top visited industry categories, they registered the highest reduction, with a 74 percent monthly decrease, after travel restrictions.

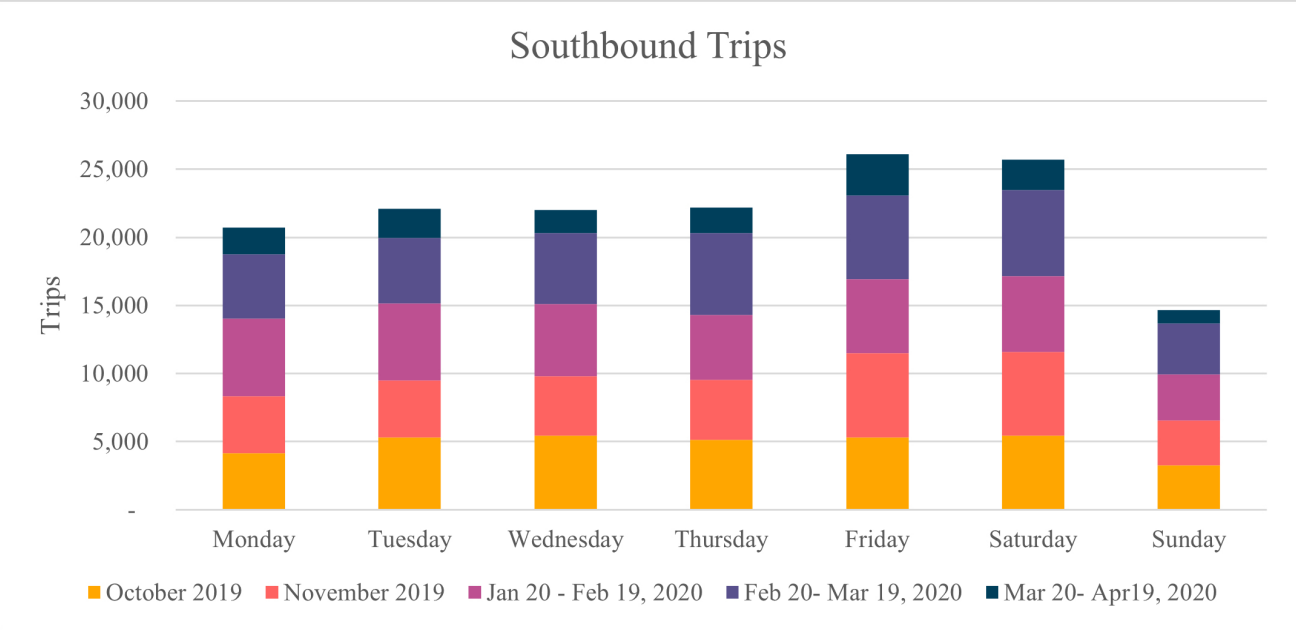

Figure 3. Southbound cross-border trip volume by day of the week

Table 2. Northbound cross-border trip volume by trip industry category

Industry Category	Before COVID-19 Related Border Restrictions					After Restrictions	
	Oct 2019	Nov 2019	Jan 20–Feb 19, 2020	Feb 20–March 19, 2020	Monthly Average	March 20–April 19, 2020	Monthly Percent Reduction
Residential	5,757	5,207	4,019	3,498	4,620	2,121	54%
Retail Trade	1,888	1,645	2,083	1,923	1,885	861	54%
Accommodation and Food Services	1,338	1,220	1,278	1,208	1,261	415	67%
Health Care and Social Assistance	369	345	448	429	398	181	54%
Arts, Entertainment, and Recreation	418	367	364	403	388	102	74%
Other Services	404	361	354	288	352	94	73%
Real Estate and Rental and Leasing	244	212	290	257	251	79	68%
Finance and Insurance	233	203	237	234	227	119	48%
Professional, Scientific, and Technical Services	230	192	267	261	238	65	73%
Transportation and Warehousing	181	157	170	150	165	73	56%
Educational Services	145	115	187	194	160	60	63%

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