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Analysis of travel behavior at international border crossings: Application of travel surveys

Jennifer Areli Moreno Escamilla
University of Texas at El Paso

ANALYSIS OF TRAVEL BEHAVIOR AT INTERNATIONAL BORDER CROSSINGS:

APPLICATION OF TRAVEL SURVEYS

JENNIFER ARELI MORENO ESCAMILLA

Master's Program in Civil Engineering

APPROVED:

Imad Abdallah, Ph.D., Chair

Ruey Long Cheu, Ph.D.

Salvador Gonzalez-Ayala, Ph.D.

César M. Fuentes Flores, PhD

Stephen L. Crites, Jr., Ph.D.
Dean of the Graduate School

ANALYSIS OF TRAVEL BEHAVIOR AT INTERNATIONAL BORDER CROSSINGS: APPLICATION OF TRAVEL SURVEYS

by

JENNIFER ARELI MORENO ESCAMILLA, B.S

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CHAPTER 1: INTRODUCTION

Transportation planning plays an essential role in the future vision of states, regions, and communities; it considers comprehensive strategies from a diverse viewpoint. (FHWA, 2023). Although it is a process in which transportation agencies, organizations, and related stakeholders collaborate to select projects that would benefit the transportation system in a region, the process has behind it a collaborative set of technical tasks that must be completed to study and identify areas of improvement.

Traffic flow models are traffic models currently studied and developed to assist decision-makers in making well-informed planning decisions. These models require representative inputs of the trip's characteristics of a study area well to generate accurate scenarios. Multiple agencies, local, state, and national, collect travel behavior data and travelers' demographic information via travel dairies, travel surveys, telephone, web-based questionnaires, and mailing, and more recently, they have been studying methods applying new technologies like crowdsourced databases and passive data collection. Obtaining trip information in binational regions is challenging, considering time and budget limitations as well as the international jurisdictions involved (Vargas et al. 2021). In binational regions, data collection of trip information has been identified as a topic of interest to study practicable methods to target the existing limitations encountered. With the population growth of binational cities along the US-Mexico borderline and the increasing traffic flow between cities, various studies have been conducted in the last decades to study travelers' behavior and understand person-trip parameters shared by two cities that fall inside two different territories.

Forecasting models require up-to-date information to represent existing trip patterns and help generate results that could represent the traffic demand at international border crossings in the El Paso-Ciudad Juarez region. Understanding trip patterns and demand is the first step toward

solving current transportation concerns such as congestion, air quality, or traffic safety **(**Vargas et al., 2021). A comprehensive study is required to study gaps in the data collection of trip information at binational regions like El Paso-Ciudad Juarez, as well as an extensive study on the trip patterns observed in this region.

1.1 Problem Statement

As the region of El Paso and Ciudad Juarez continues to grow and border commuters endure long waits to cross the border (BorderReport, 2023), it is essential to understand the demand of trips to study and model improvements that could benefit the border commuters. Up-to-date travel behavior is very limited in binational regions, and at the same time, various studies reported results on trip information before COVID-19. Therefore, a comprehensive study is needed to collect representative data on the existing conditions in the El Paso-Ciudad Juarez binational region. Updating information parameters like trip purposes, volume crossings, and origin-destination information of trips could improve the results obtained from modeling the international border crossings (IBCs) at macroscopic and microscopic levels.

1.2 Purpose of Study

This research aims to generate a representative study of the binational region of El Paso and Ciudad Juarez to generate an analysis of the trip information. This study presents the responses from passenger vehicles, pedestrians, and commercial truck commuters crossing the border in both northbound and southbound directions. A survey questionnaire was designed to collect the following information:

- Place of residence
- Trip origin location and purpose
- Trip end location and purpose

- Crossing information by direction and by border crossing
- Expected waiting time and income
- Truck drivers were asked about the type of freight

The study aims to study the travel behavior of commuters in the El Paso-Ciudad Juarez region throughout the four seasons of the year to study the patterns that occur between seasons and observe how different conditions (weather, off-school season) may impact person-trips.

1.3 Outline of Report

The body of the report consists of five chapters, including the current Chapter 1. Chapter 2 consists of a comprehensive literature review of methods to collect travel information, like travel surveys, travel diaries, and new data collection technologies. Chapter 2 also presents various case studies applying these methods in various case studies at central regions and binational cities in the U.S.

Chapter 3 describes the methodological details applied in this study, including a survey methodology of the data used. Chapter 4 reports the analysis conducted on the trip information by modes, privately-owned vehicles, pedestrian, and commercial trucks.

Chapter 5 discusses the application of travel data on travel demand modeling and summarizes findings, conclusions, and recommendations.

CHAPTER 2: LITERATURE REVIEW

Transportation planning relies on representative and reliable travel data to forecast future projects in urban or rural areas. Over the years, traditional survey methods have been applied to collect travel behavior data, but several innovative technologies have been introduced in recent years. Although planning agencies have access to various travel data records, binational cities require more representative data due to the distinct characteristics shared by two cities in different nations. This chapter includes comprehensive literature on travel data collection methods and various case studies that have studied these data collection methods in binational cities.

2.1 Travel Modeling

Travel modeling is used to generate traffic forecasts built from forecasted land use and travel patterns distinctive from the region of study (ODOT, n.d). It is fundamental for regional planning agencies to have the most up-to-date data inputs to be able to model what-if scenarios that could reflect results under existing conditions. The most traditional data collection method is travel surveys due to the level of detail they can collect. However, these methods tend to be limited by high costs, sporadic updates, small sample sizes, and underreporting **(Lee, 2016).** This section aims to provide an overview of the methods applied in several studies.

2.1.1. Travel Surveys and Travel Diaries

According to the New York Metropolitan Transportation Council (n.d), a travel survey is a method to collect information to gain an understanding of regional and national travel behavior. In various studies, agencies also integrate travel diaries into the methodology to collect trip information at a study region. A concise comparison between both techniques is that travel surveys can collect only primary data and key components of a survey. On the other hand, travel diaries enhance the data collection with information on the traveler's mobility for extended periods, giving

a chance to provide trip information for 24 hours. These techniques can be classified as conventional since they have been used by agencies whose primary focus is to study demand modeling for several years. Travel surveys and diaries may include face-to-face interaction between survey administrators and respondents, via telephone, web-based, or surveying methods. Data retrieved from travel surveys contributes key information for traffic planners, infrastructure authorities, and transportation scientists (Nitsche P et al. 2013).

2.1.2. Trip surveys and diaries applied in binational regions.

Gathering travel behavior information of urban and rural regions is not easy to complete under a region's usual conditions. However, complexity increases in binational cities where cross-border trips represent a significant part of daily trips and can be underrepresented in travel behavior studies (Vargas et al., 2021). This scenario is the case of the border cities along the US-Mexico border line, where thousands of travelers cross the border daily to complete their activity demands**.** During the last decades, various case studies have been applied along the US-Mexico border to understand the trip behavior that occurs inside binational regions and provide reliable databases with representative data that has supported the development of a calibrated model to forecast projects in the region. This section is an overview of previous studies that have been applied at various binational cities to acquire and study the trip behavior of the region.

I. San Diego-Tijuana Travel Behavior Report

San Diego Association of Government (2020) applied a methodology of administrating travel surveys and travel dairies to northbound border crossers. The primary subject to study was Mexican residents and other travelers crossing in personal vehicles and buses and walking. The study involved two interviewing stages, in which the respondents answered initial questions

focused on collecting household-level characteristics, primary trip information, and value of time data. Only Mexican residents were asked to take the second stage of the survey, which consisted of asking the respondents to complete a travel diary portion to study the places they visited in the United States for 24 hours. The travel information was retrieved during a follow-up interview in person at some points around the region, through an online survey, or via telephone.

Since the study methodology was based on administered travel surveys with travel diaries, the agency collected 7899 complete first-stage questionaries that included key components of the trip information of northbound travelers in the United States, but 1911 travel diaries were completed by Mexican residents. SANDAG used the travel diaries collected to study the trip stops in the U.S. throughout the day and analyze the travel behavior of respondents in San Diego County. The primary purpose for Mexican travelers was shopping, with the highest percentage of 52%, followed by work and recreational-related activities. Additionally, they review the number of hours in the U.S. (Figure 2.1), the average number of stops, the duration of destination visits, and the destination location based on the port of entry used. This information was obtained from the Mexican travelers who reported their 24-hour period travel dairies.

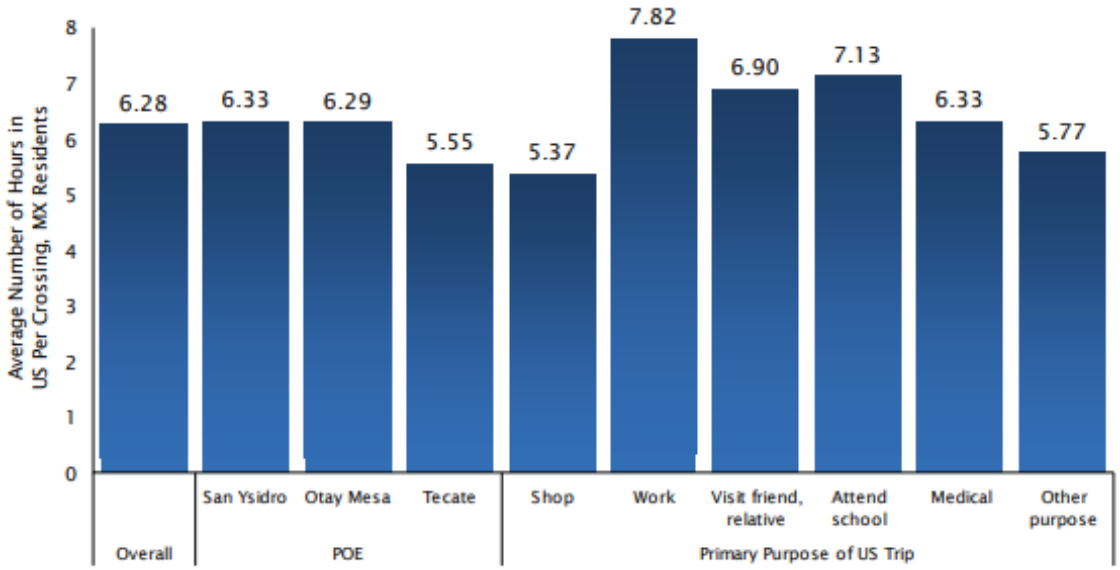

Figure 2.1. Average number of hours in U.S. per crossing by POE & primary purpose of U.S Trip (SANDAG 2020)

II. Mexicali Imperial Valey cross border mobility study

Gutierrez M et al. (2021) proposed two approaches to study the mobility of travelers in medium-small regions along the US-Mexico borderline, like the region of Mexicali-Imperial Valley. In the study, they use historical data available in national agencies' records to characterize the local-regional context and the impact of the number of crossings in the region. The second approach was a disaggregated analysis based on zoning and household survey design and application. The study follows a random sampling approach to determine the households to be surveyed. Figure 2.2 shows the sections in which the Mexicali region was divided and the block where surveys were administered.

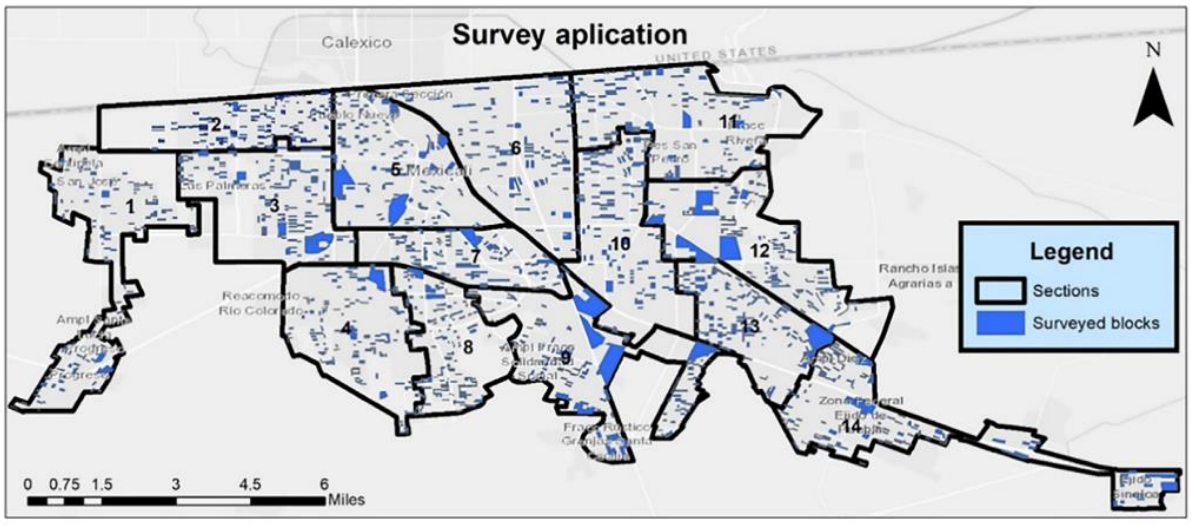

Figure 2.2. Distribution of blocks for applied surveys on the representative sample (Gutierrez M et al. (2021)

Contrary to other studies where the place of application of the surveys was closer to the International Border Crossings located along the borderline, in this study, the surveys were administered at random households on the Mexican side. In this study, cross-border travelers' primary motives for going to the U.S. were shopping/merchandise consumption, followed by recreational.

III. El Paso Ciudad Juárez International Bridges Crossborder Survey

Fuentes (2020), in partnership with the City of El Paso, studied the travel behavior at El Paso Ciudad Juarez for six months under an agreement with the Colegio de la Frontera Norte (COLEF). The study area considered were four of the six IBCs located along the borderline: Bridge of the Americas, Paso del Norte, Stanton/Lerdo, and Ysleta/Zaragoza. The survey was conducted only on weekdays from October 2019 to March 17, 2020. The surveys were administered based on residence; Mexican residents were given an "entry" survey, and travelers with primary residence

in the United States were given an "exit" survey. This approach was determined to differentiate future activities from those that had already been completed.

The report summarizes the findings obtained from the statistical analysis and highlights some limitations identified during the study. The key parameters reported in the results were distribution of primary place of residency, gender, age range, by POE and mode, reasons for crossings, and spending activity. Compared with previous studies, analysis results on trip purposes are consistent with other studies; the primary purposes reported for Mexican residents shopping with 40.7%, followed by social, work, and educational activities.

2.1.3. Digital technologies used for trip data collection

Travel diaries and travel surveys are conventional techniques that are reliable for many agencies to obtain trip information, and they continue to be one of the most used. Despite that, new technologies have been introduced in the last two decades. New methods have been studied to explore this research area to fill in the gaps by improving the size of samples without compromising projects' costs and other parameters. Emerging data have not been classified into one definition, but instead, the following terminology has been used to refer to them: vehicle tracking data, crowdsourced data, and passive data (Lee, Sener, 2020). Since conventional survey methods represent high costs when dealing with long data collection periods, they also represent many challenges and limitations in the field and a reduced sample size able to be collected. This gap of information and challenges are study areas that are being studied due to the facility that many technologies like smartphones have opened to collect trip information.

2.1.4. Case studies on digital technologies applications

I. Cross-border trip characteristics using crowdsourced data

Vargas et al. (2021) explored and evaluated cross-border trip characteristics using crowdsourced data. The study's primary source of information was INRIX data, which provided detailed information on a continuous time and space spectrum. The study was conducted for three months; hence, only three months of data were purchased. INRIX provided data in two different sets: trips and trajectories. They identified that the trip information datasets provided the location of the origins and destination of the trip, which included the exact timestamp.

In contrast, trajectories datasets reported the segments crossed during the trip. Extensive data cleaning was needed to identify the variables and number of entries valuable for the study. Table 2.1 shows the results obtained by the research team once the data-cleaning process was concluded. The total number of northbound trips in the full dataset was 50,011, and the total number of traceable northbound trips was 4,830. They detected that the number of traceable trips was much lower than expected and that the records reported a high number of heavy vehicles that could result in sampling biases.

Table 2.1 Number of Trips in the INRIX final clean datasets (Vargas et al. 2021)

INRIX sample dataset	Direction of trip	LPOE	Total
Full dataset	NB	BOTA	13,203
		PdN/Stanton	13,466
		Zaragoza	22,332
		Santa Teresa	1,010
		Total	50,011
	SB	BOTA	33,569
		PdN/Stanton	13,596
		Zaragoza	34,434
		Santa Teresa	4,789
		Total	86,388
Traceable dataset	NB	BOTA	1,212
		PdN/Stanton	643
		Zaragoza	2,673
		Santa Teresa	302
		Total	4,830
	SB	BOTA	2,204
		PdN/Stanton	499
		Zaragoza	4,611
		Santa Teresa	1,604
		Total	8,738

Researchers examined and compiled additional data and merged it with the INRIX trip data to provide a more detailed perspective of the trip patterns. They focused the study on vehicle type, trip time, trip distance, and trip purpose. Data was segregated by location, and a trip purpose was assigned based on the location of its destination. They identify only three primary purposes: shopping, education, and medical. The destination coordinates determined the trip end location. Figure 2.3 shows the results obtained from their study and shows how restrictions during COVID-19 impacted the number of trips registered in the database. Even considering this, the primary purpose of the trip reported was shopping.

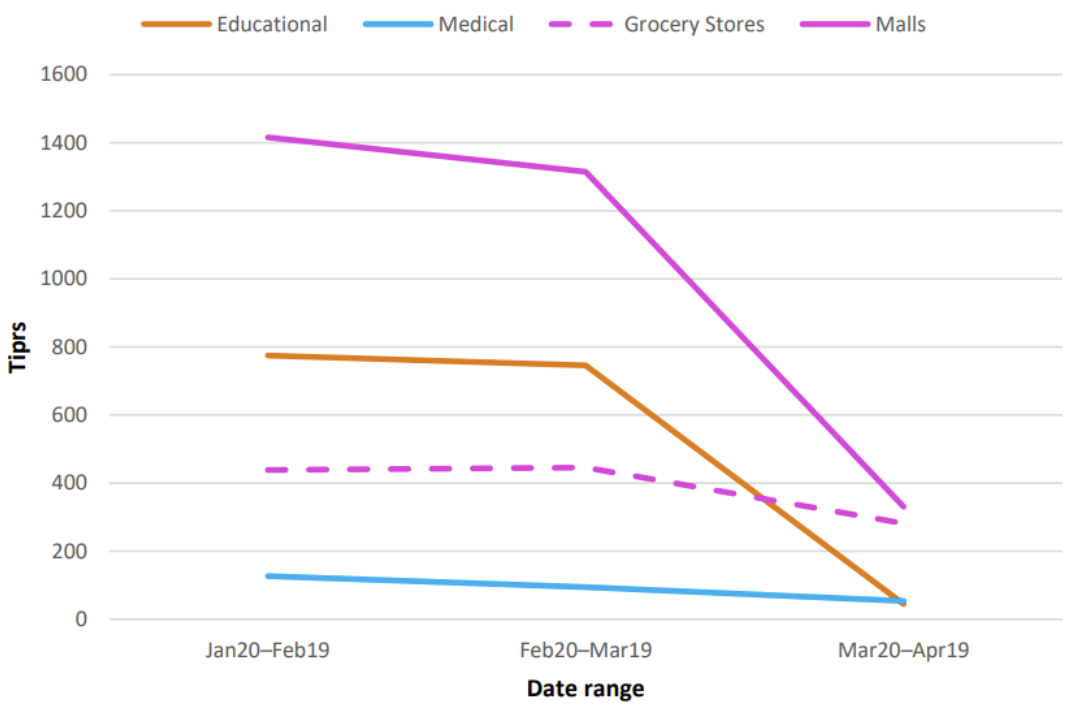

Figure 2.3. Cross-border trips to El Paso by Trip purpose by Month (Vargas et al. 2021)

II. Application of emerging data in border crossings

Gurbuz et al. (2022) aimed to explore northbound cross-border trips using location-based data sources to build on the Vargas et al. (2021) study. The study focused on the evaluation of the location-based services database SafeGraph. The data obtained from SafeGraph was point-of-interest based on business listing and location information that third-party providers provide. To conduct this study, they collected places and patterns databases for the state of Texas; the variables used from the databases were the following: location I.D., location name, brands, North American Industry Classification System (NAICS) code, latitude and longitude, data collection, data collection period, visit counts, and visitor country of origin. The trip end location was determined using the NAICS code, the American Industry Classification System categorical coding. Table 2.2 lists the number of cross-border travelers distributed from the places visited by Mexican residents.

The results showed that the primary trip end locations visited by Mexico-domiciled travelers were retail trade, real estate/rental and leasing, and accommodation and food services.

Table 2.2. Cross-Border Mexico-Domiciled Travelers by Sector (Gurbuz et al. 2022)

NAICS Code	Definition	Total Mexican Visitors	Percent Distribution
22	Utilities	67	0.0%
23	Construction	2,113	0.1%
31–33	Manufacturing	12,530	0.3%
42	Wholesale Trade	8,004	0.2%
44–45	Retail Trade	1,733,605	44.2%
48–49	Transportation and Warehousing	41,449	1.1%
51	Information	21,377	0.5%
52	Finance and Insurance	35,184	0.9%
53	Real Estate and Rental and Leasing	497,376	12.7%
54	Professional, Scientific, and Technical Services	7,033	0.2%
55	Management of Companies and Enterprises	630	0.0%
56	Administrative and Support and Waste Management and Remediation Services	2,676	0.1%
61	Educational Services	76,889	2.0%
62	Health Care and Social Assistance	116,203	3.0%
71	Arts, Entertainment, and Recreation	227,479	5.8%
72	Accommodation and Food Services	1,067,159	27.2%
81	Other Services	63,009	1.6%
92	Public Administration	11,772	0.3%

The key findings of this study were the following: INRIX provides data for all northbound trips (U.S. and Mexican residents), but Safegraph may capture the ability to capture trips made by a traveler from Mexico. In the end, the comparison between the two sets of data (INRIX and

SafeGraph) in which it was possible to see the distribution of trip-end location. They identified slight differences between trip destination distribution, which was justified by the fact that SafeGraph only reported trip information of Mexican residents. Even considering differences in INRIX percentages compared to the results obtained using SafeGraph database, the primary destination was retail trade, which involves the consumption of merchandise, as shown in Figure 2.4.

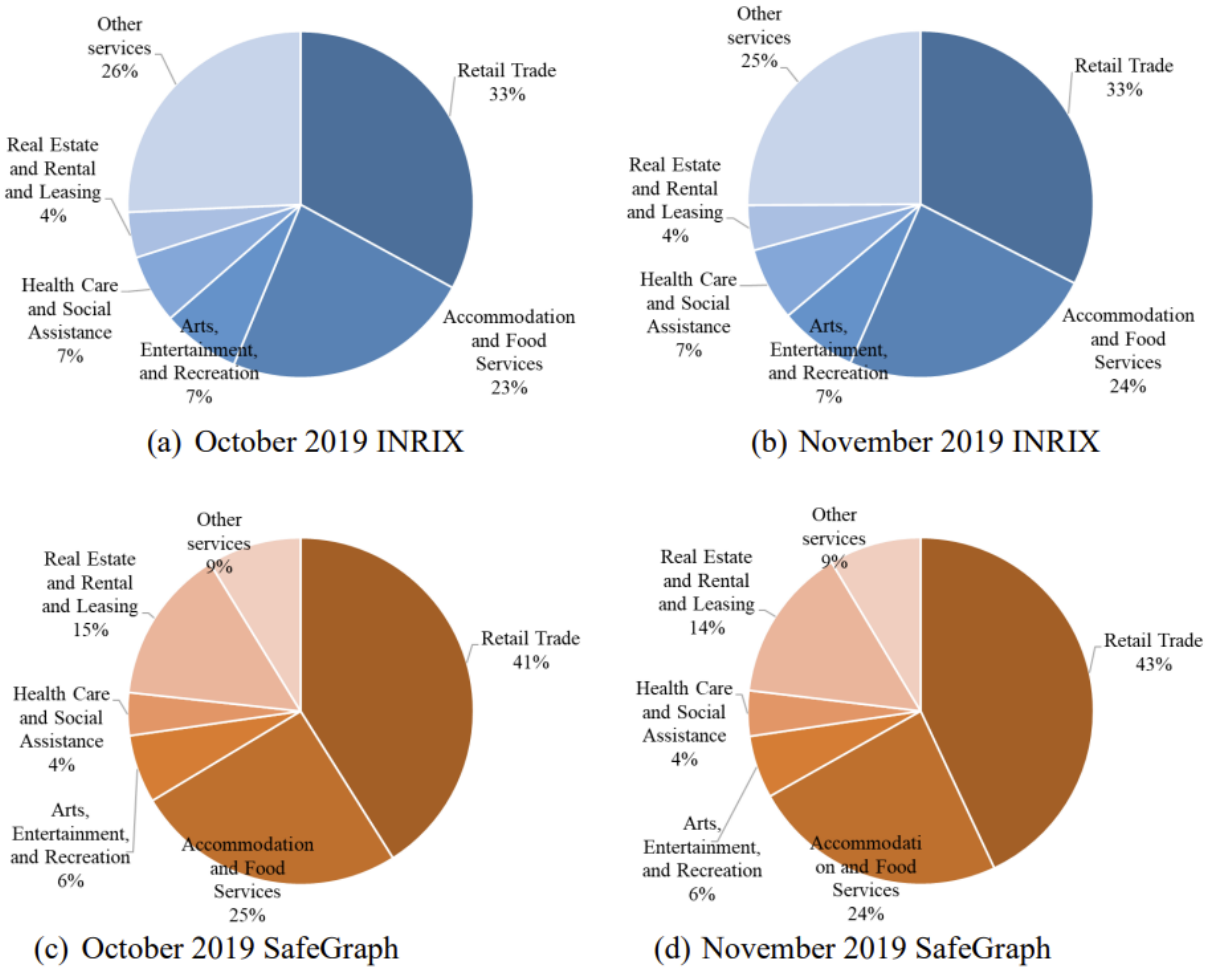

Figure 2.4 Northbound Trip Destinations by Industry Sector (Gurbuz et al. 2022)

CHAPTER 3: TRAVEL SURVEYS

3.1 Methodology

The primary goals of this study were to 1) design the survey questions along with the agencies associated with the project, 2) collaborate with the Colegio de la Frontera Norte (COLEF) to conduct the surveys, 3) run data processing and perform data analysis. The first step consisted of identifying the study scope in the region. The El Paso region has six border crossings that stretch from the west side at Santa Teresa, New Mexico, to the east at Tornillo, Texas (PDN 2023). For this research, the target points were 5 International Border Crossings located along the borderline that separates the border cities of El Paso, TX, and Ciudad Juarez, Chihuahua: Bridge of the Americas, Paso del Norte, Stanton, Santa Teresa, and Zaragoza (Figure 3.1)

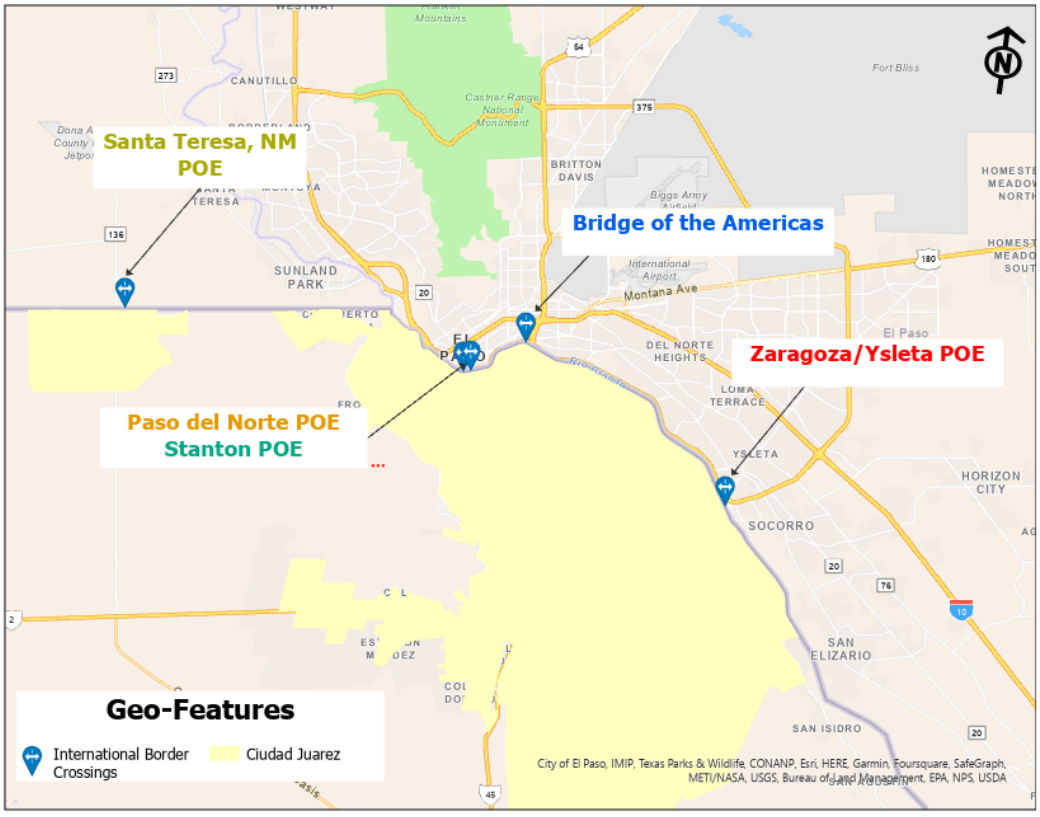

Figure 3.1. International Border Crossings - El Paso-Ciudad Juarez region

The project objective was to gather representative travel data throughout the year to understand the travel patterns from all modes of all seasons (fall, winter, spring, and summer) by conducting travel surveys at the IBCs established for this study. To meet the standard of research with human subjects due to the interaction with respondents, the study was reviewed and approved by the Institutional Review Board, categorizing the study as "exempt." The research was not required to be subjected to continuing reviews, keeping in mind that no modifications were made after the initial review.

The surveys were conducted by COLEF staff on Mexican territory, so it was necessary to have Mexican authorities' authorization to conduct surveys at the northbound toll booth entries and the primary inspection exit gates. The surveys were conducted only during weekdays and did not consider official holidays. The idea behind collecting four seasons of surveys was to study the travel patterns between all the seasons and identify their similarities and differences. Table 3.1 shows the sample dates selected for each season, starting from November 2022 and ending in July 2023.

Table 3.1. Weekday sample periods scheduled for each season

	Days
First Season	November 11, 2022, to December 9, 2022
Second Season	December 13, 2022, to January 6, 2023
Third Season	March 13, 2023, to April 21, 2023
Fourth Season	July 10, 2023, to July 28, 2023

Questionaries were recorded using electronic tablets as U.S. and Mexican travelers crossed northbound and southbound. Figures 3.2 to 3.4 show the staff conducting surveys at all three

modes at different border crossings. The equipment used in the field to conduct the surveys was an application designed by COLEF in which the interviewers entered the answers on tablets. Questionaries were divided into four main sections: commuters' demographics, origin-destination information, income, and crossing time expectations. Commercial truck drivers were asked questions about goods mobility, which will be discussed in the following sections.

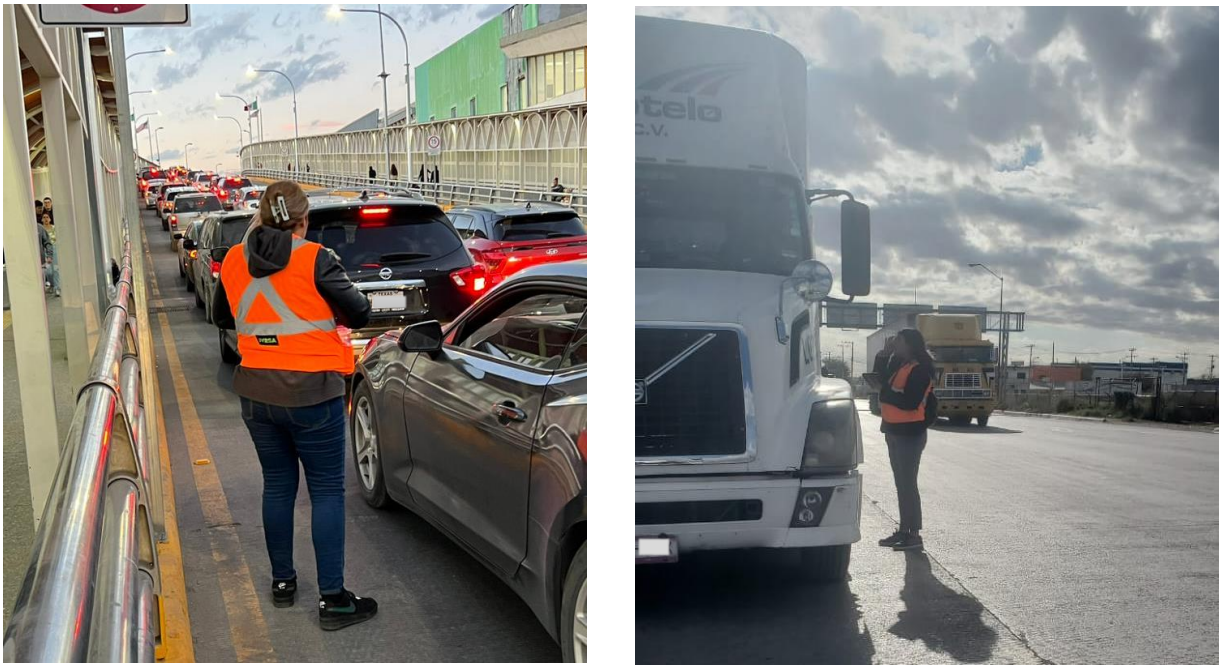

Figure 3.2 & 3.3 Passenger Vehicles Survey at PDN (left) and Ysleta commercial trucks traffic flow (right)

Figure 1.4 Pedestrian surveys at Bridge of the Americas

3.2. Data Sources

For this study, three primary data sources were necessary to analyze the trip characteristics at the international border crossings and to study the traffic flow behavior. Origin-destination information, historical crossings data during the study period, and delay and queuing patterns during peak and off-peak periods. The first data set came from the travel surveys conducted in this study over a four-season period. In the surveys, respondents were asked for information such as trip purpose and the intersection of location from the origin-destination endpoints for their trip.

The second data source was obtained from various sources. U.S. Customs and Border Protection (CBP) provided hourly northbound crossings for personal vehicles, pedestrians, and commercial trucks. Hourly southbound crossings were reported for personal vehicles at Ysleta/Zaragoza and Stanton Lerdo, and commercial vehicles at Zaragoza were provided. Historical hourly southbound crossings data could not be retrieved from any public or private

agency. Hence, with the support of Cambridge Systems, it was possible to recover data for one day at some crossings like Bridge of the Americas and Santa Teresa; due to this limitation, it was necessary to assume some conditions for this study that will be covered in the following sections. Lastly, with the support of the International Border Crossings, it was possible to gather a set of video recordings, making it possible to recover hourly southbound crossings of pedestrians at Paso del Norte, Stanton/Lerdo, and Ysleta/Zaragoza. The third set of data was requested by the City of El Paso International Bridges Department and collected in the field or from video recordings.

3.3. Sample Design

To make sure that the sample of persons surveyed was representative of the number of crossings, a stratified random sampling was used to adjust the sample's actual number of crossings. To do this, the selection was divided into two stages: selection of the number of survey shifts and random selection of respondents. Based on available resources, 57 survey shifts were defined and divided into 28 southbound and 29 northbound shifts. The second stage was constructing strata by bridge, mode, and shift. Considering five IBCs with three respective modes each and two shifts, morning and afternoon, the study was divided into 30 bridge-mode-shift strata. The hour shifts considered were from 7:00-14:59 and 15:00-22:59 pm; the rest of the hours of the 24 hours were excluded due to safety concerns.

The second stage happened once in the field when interviewers started their shift at the assigned IBC. Random selection was based on an imaginary pre-determined by the coordinator during the initial design of the methodology applied in the field. Interviews applied the questionnaire to the vehicle, pedestrian, or truck leading toward the IBC lanes. Respondents were asked for their consent and eligibility; users had to be 18 years old or older. If a vehicle had more than one passenger, the interviewer followed a system of random number generator to determine which passenger to interview. After the questionnaire had been concluded, the interviewers returned to their initial positions and continued repeating the process during the survey shift. In

the case of southbound privately owned vehicle trips, the survey coordinator received authorization from Mexican authorities to conduct surveys to users who were stopped by Mexican authorities for a secondary inspection. Interviewers applied the questionnaire to the passengers once the Mexican Aduana concluded the vehicle inspection. For all modes, the interviewers had permission to conduct the survey up to the divisionary line between the US-Mexico territory.

3.4 Sample Weighting

The final unweighted sample size was calculated after collecting data for all seasons, having a total unweighted size for all modes of 3299 complete surveys. The next part was to generate sample weights by mode, IBC, and shift hour information. For this, the average hourly crossings by bridge and mode are estimated from the number of crossings requested from CBP, the City of El Paso International Bridges Department, and other agencies. The weighted factor was generated from the relationship between the number of questionaries and the average number of crossings during the day. The inverse fraction for the following fraction was used to expand the sample:

$$\frac{q_{ijk}}{c_{ijk}}$$

- q_{ijk} represents the number of questionaries conducted by hour i, day j, and strata k
- c_{ijk} represent the average number of crossings for each mode by hour i, day j, and strata k

3.5. Data Processing

Each trip had to be assigned a trip purpose category and traffic analysis zone. In this study, there were 10 trip purposes identified and coded; Table 3.3 shows a table with the list of all trip purposes coded and their description. Additionally, every entry origin and destination pair were

geocoded to identify their correct traffic analysis zone to study the distribution of the trips throughout El Paso and Juarez. To do this, every entry had to be searched using a geographic information system and geolocate the origin and destination intersection streets or places reported on the survey. GIS software was introduced in this stage of the project due to the accessibility it provides to locate street names using the locator tool and the access to create feature layers with attribute tables to save the trip information of each origin and destination intersection geolocated.

Table 3.2 Trip Purposes Codes

Code	Name	Description
HBW	Home- base Work	Trip Production at home Trip Attraction at work
HBED1/ED2	Home-based education	Trip Production at home Trip Attraction at educational sites
HBHlth	Home-based health	Trip Production at home Trip Attraction at medical sites
HBShp	Home base Shop	Trip Production at home Trip Attraction at shopping center/gas stations/restaurants
HBRec	Home base Recreational	Trip Production at home Trip Attraction at recreational places
HBImmigration	Home base Immigration	Trip Production at home Trip Attraction at sites for immigration processes
HBH	Home base Home	Trip Production at Home Trip Attraction at Home
HBP/D	Home base Pick up/ Drop off	Trip Production at Home Trip Attraction at places to pick up and drop off someone
HBO	Home base Other	Trip Production at Home Trip Attraction at other places not classified previously
NHB	Non-Home Base	Trip Production/Trip Attraction at non-home sites

CHAPTER 4: RESULTS AND DISCUSSION

4.1. Survey Data Analysis

A descriptive statistical analysis was done to summarize and present the results obtained from the travel surveys collected throughout the four seasons.

4.1.1 Transborder trips

I. Privately Owned Vehicles

The data collected from the surveys made it possible to analyze the distribution of transborder trip categories reported during the sample days. Transborder trip categories included internal-internal, external, internal, and external-external. Any trip with an outer trip ends from the study area, El Paso metropolitan area, and Juarez. Figures 4.1 to 4.4 show the distribution resulting from the four seasons studies in this project. As can be observed, most estimated trips reported at all international border crossings were internal-internal, meaning that they were completed locally. Additionally, the highest percentage of internal-internal trips were from Mexican travelers.

Another parameter that could be observed from the results was the number of external-external and external-internal or internal-external trips that increased during off-school seasons. This pattern is more noticeable during the winter holiday season than during the summer break. Data of external-external trips during the winter holiday season reported a weighted sample of 3175 trips; 83.3 % of the trips were reported by U.S. residents and 16.7 % by Mexican residents.

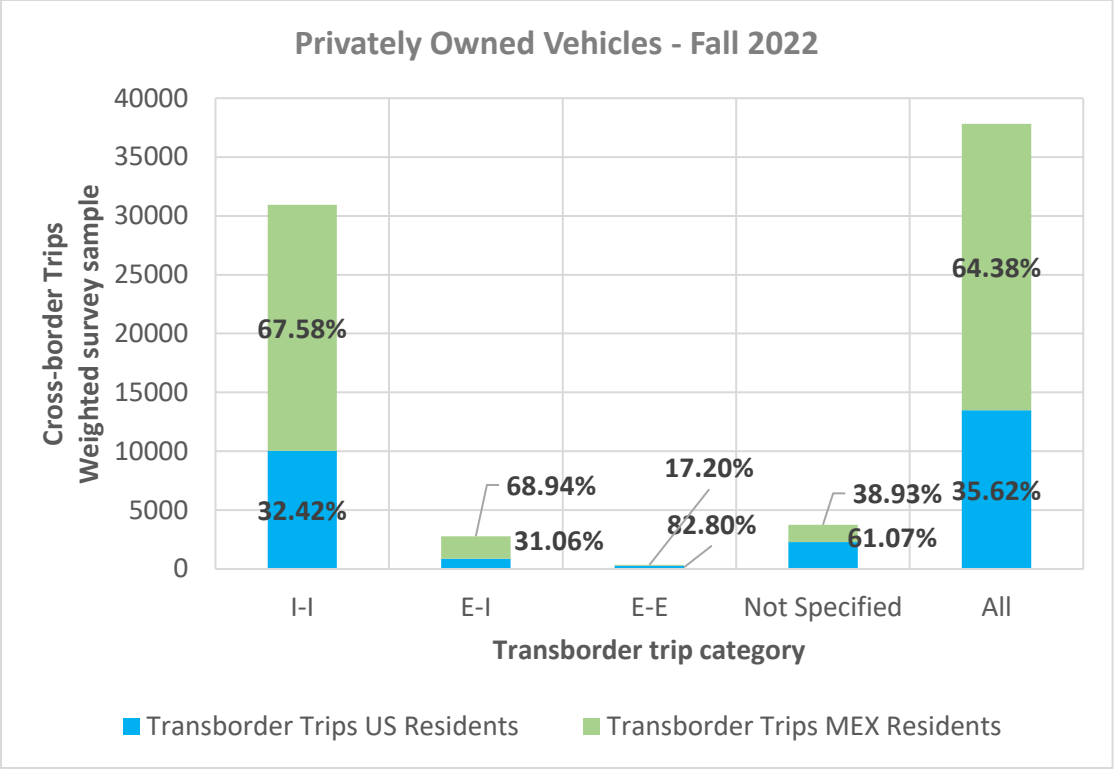

Figure 4.1. Estimated weekday transborder trips by private-owned vehicles during Fall 2022

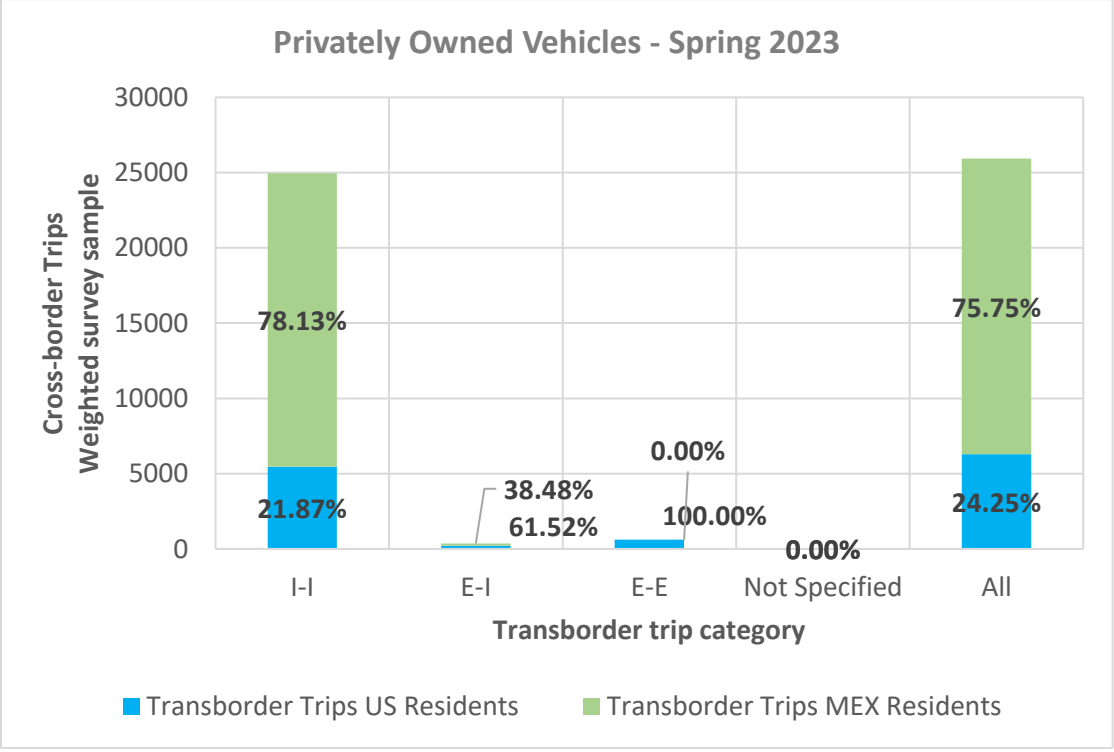

Figure 4.2. Estimated weekday transborder trips by private-owned vehicles during Spring 2023

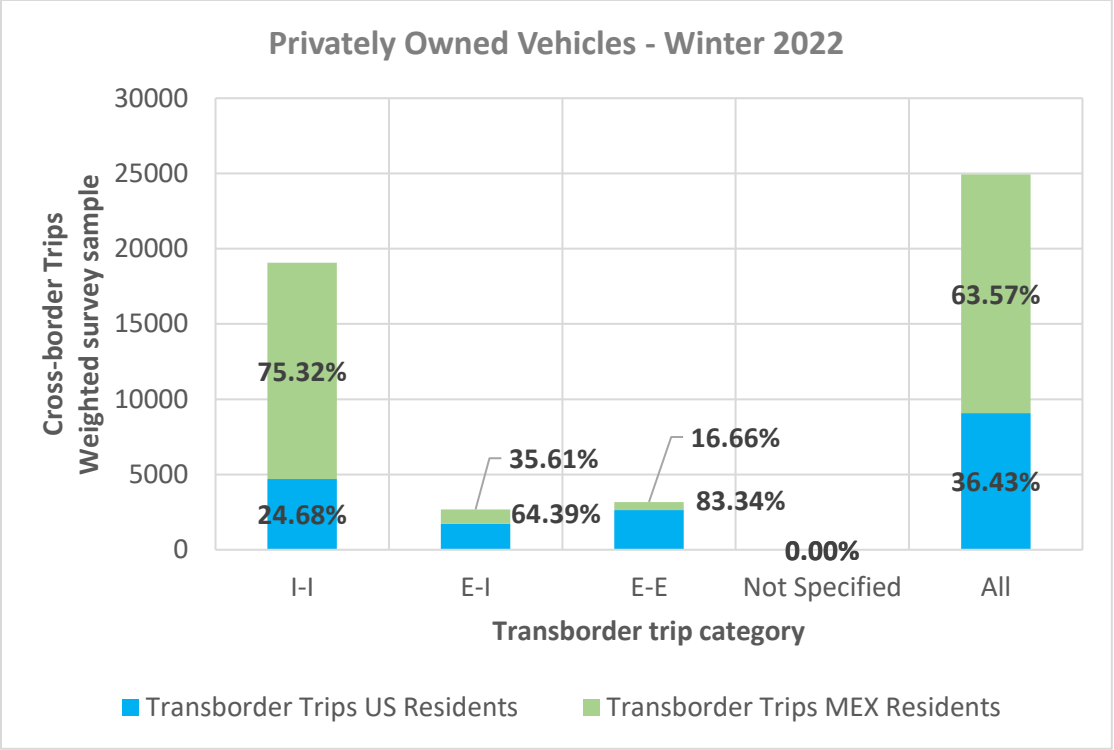

Figure 4.3. Estimated weekday transborder trips by private-owned vehicles during Winter 2022

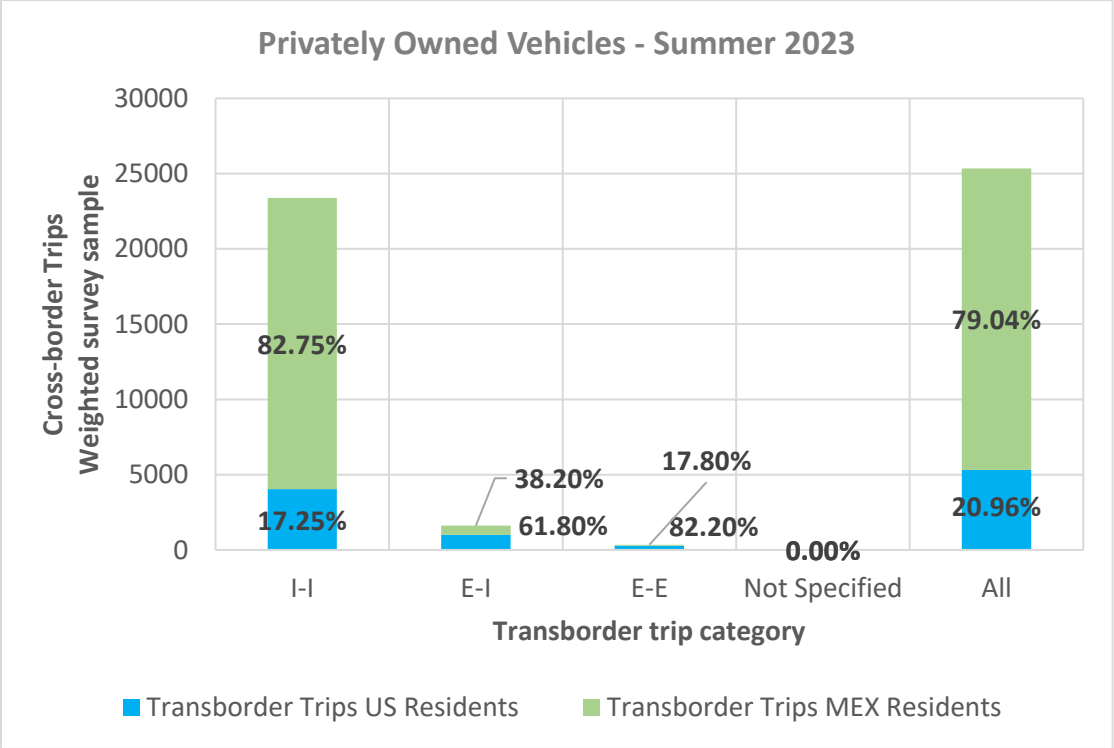

Figure 4.4 Estimated weekday transborder trips by private-owned vehicles during Summer 2023

II. Pedestrians

Following the same methodology applied to privately owned vehicles, Figures 4.5 to 4.8 show the estimated weekday transborder pedestrian trips, including all northbound and southbound trips. For this study, pedestrians were only users who walked toward the IBC entry or exit and crossed the border walking; however, no information on how they continued the trip was retrieved from the survey. Under this context, an average of 77.1% of estimated trips were reported for all transborder trips by Mexican travelers during the four seasons; U.S. resident travelers represented the other 22.9%. In contrast to privately owned vehicles, for pedestrians, almost no external-external trips were reported throughout all seasons of the year. The number of pedestrian trips completed in El Paso and Juarez are primarily classified as internal-internal trips, as observed in the results reported below.

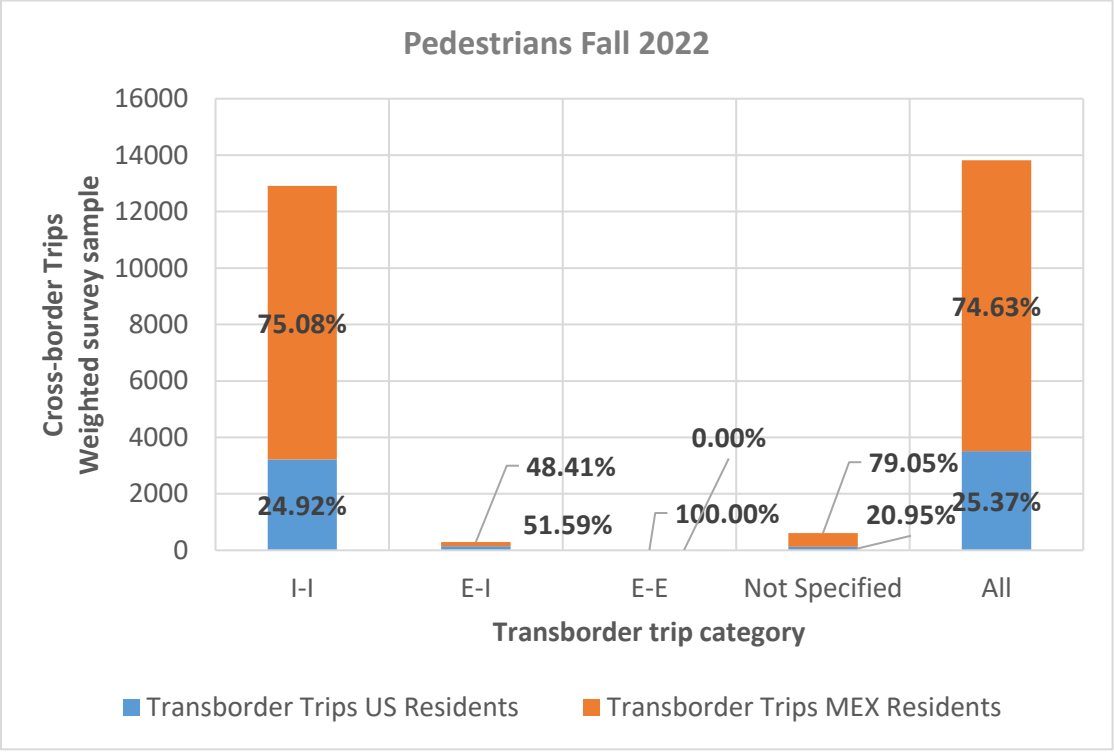

Figure 4.5. Estimated weekday transborder trips by pedestrians during Fall 2022

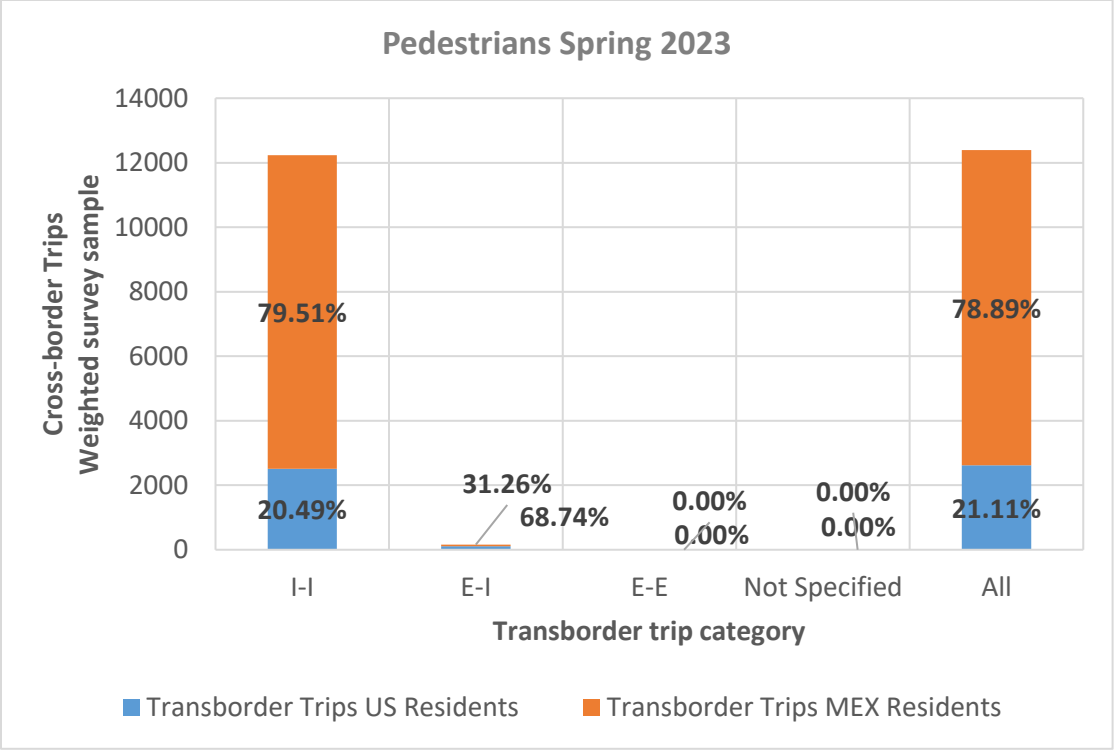

Figure 4.6 Estimated weekday transborder trips by pedestrians during Spring 2023

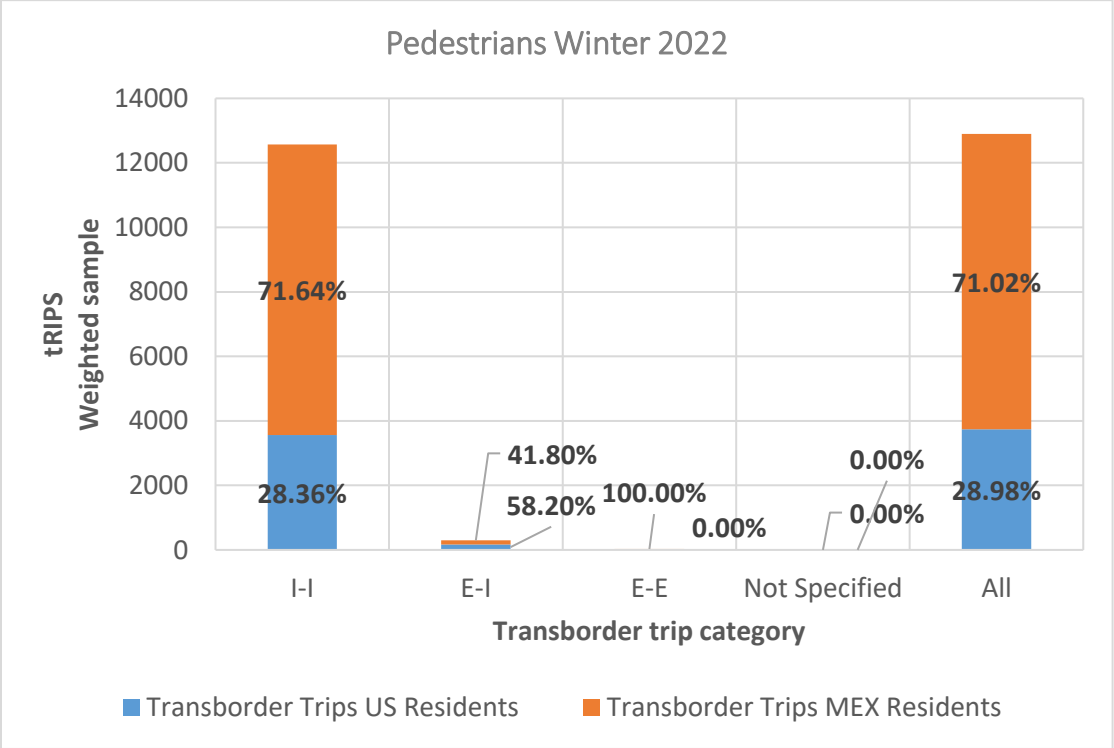

Figure 4.7. Estimated weekday transborder trips by pedestrians during the Winter 2023

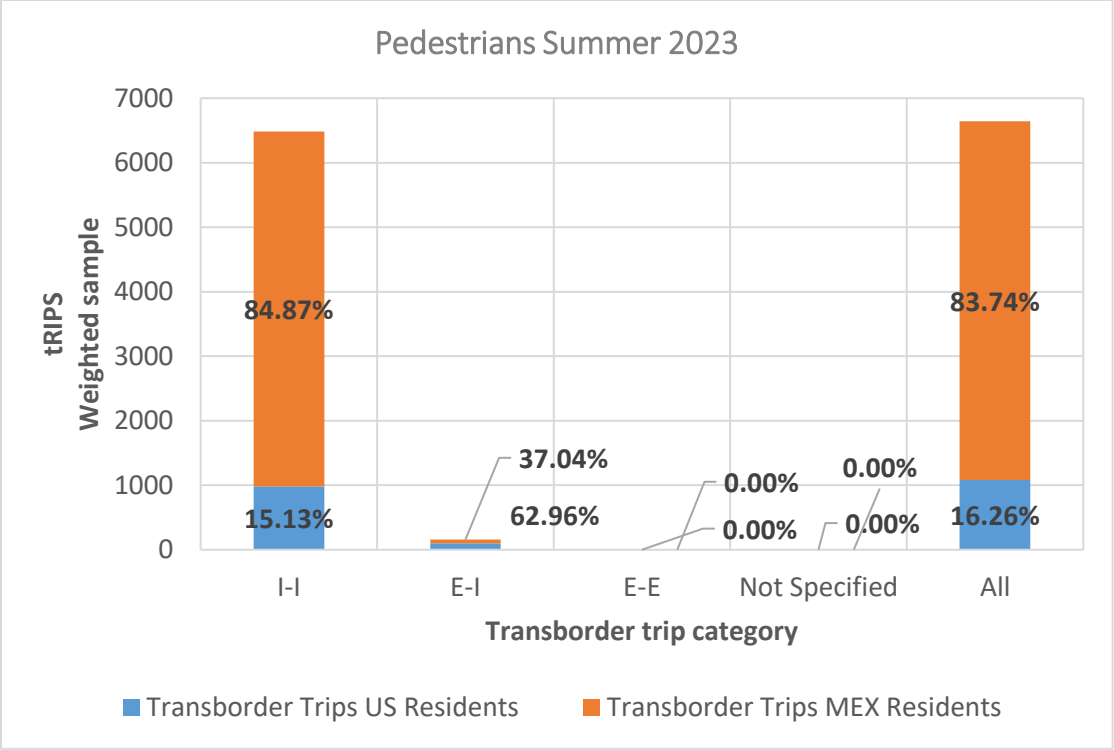

Figure 4.8 Estimated weekday transborder trips by pedestrians during Summer 2023

4.1.2. Trip Purpose Analysis

I. Northbound Trips Privately-Owned Vehicles

Trip purpose results were analyzed to show the distribution of trip purpose by U.S. and Mexican travelers. As shown in Figures 4.9 and 4.10, the primary trip purposes of Mexican residents stayed between work, shopping, and recreational, aside from the U.S. residents' trip distribution, whose primary purposes were recreational, shopping, and health. Since northbound crossings on Stanton dedicated commuter lanes (DCL) were not acquired, additional estimated crossings were considered assuming no trip purposes distribution applied, considering that the number of crossings through Stanton DCL can represent up to 13% of all the northbound daily crossings at all IBCs. This percentage also includes the estimated hourly crossings at IBCs where it was not possible to collect trips by U.S. or Mexican residents.

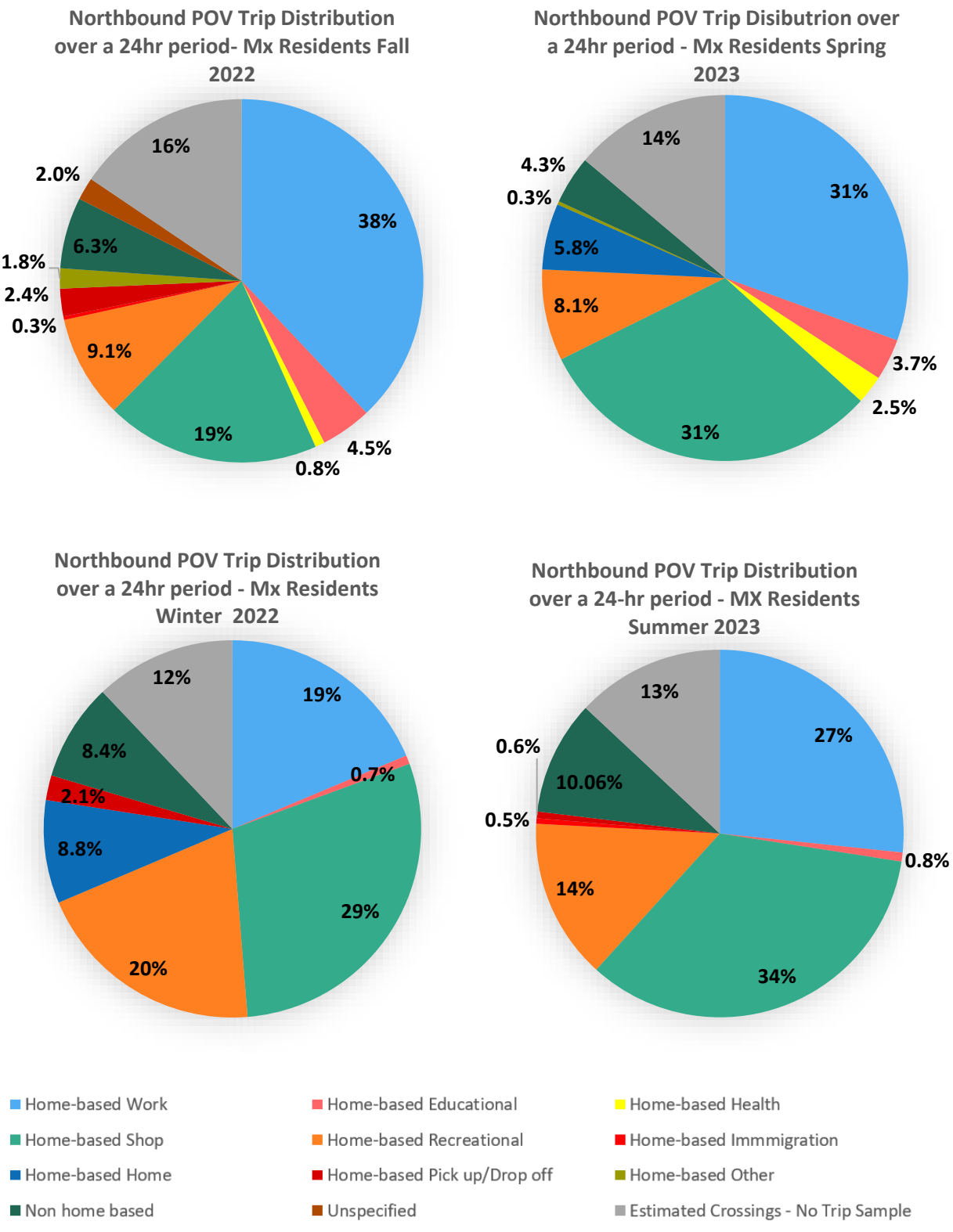

Figure 4.9 Estimated NB private-owned vehicles trip purpose distribution by Mexican residents over a 24-hour period

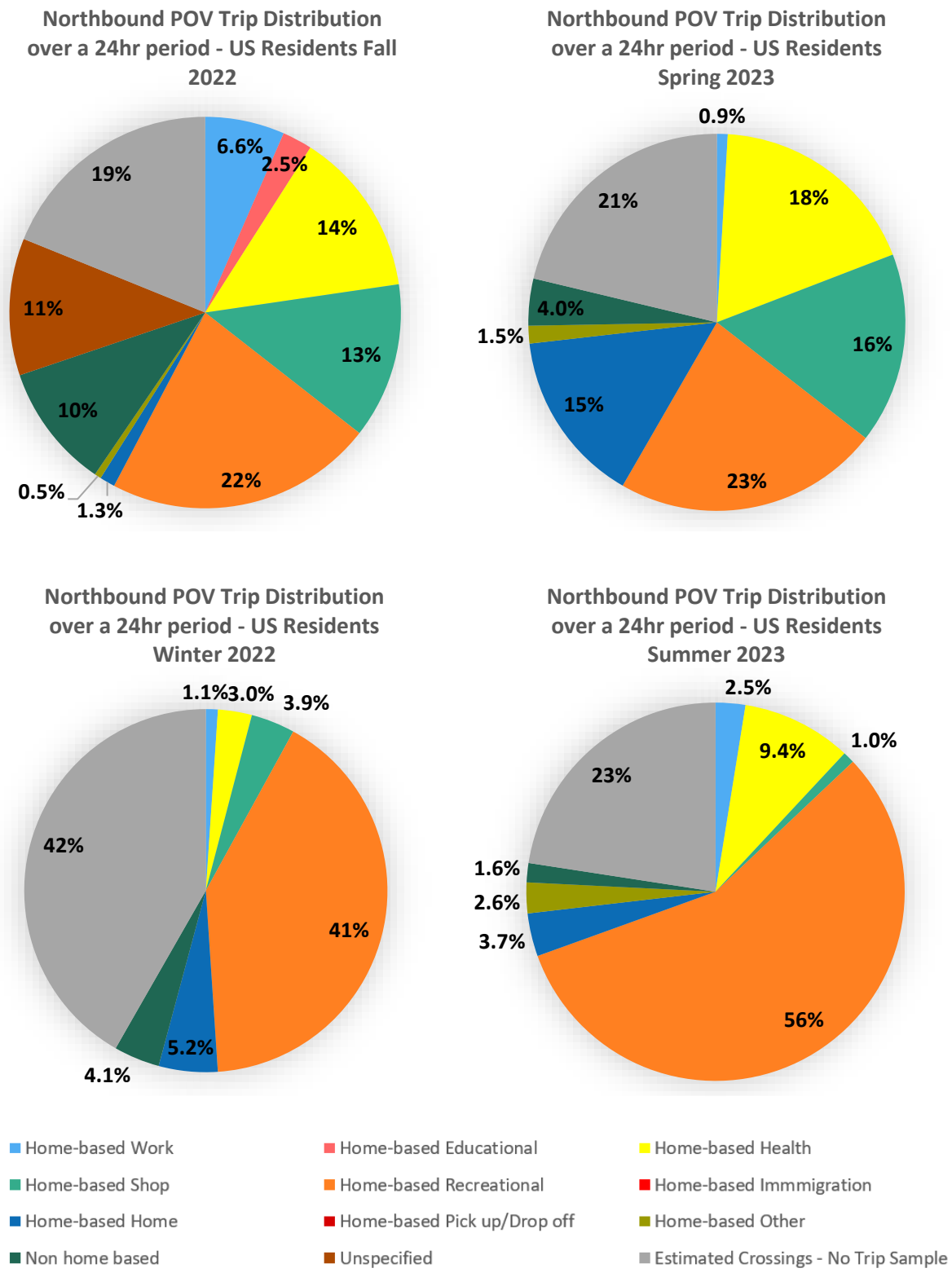

Figure 4.10. Estimated NB private-owned vehicles trip purpose distribution by U.S residents over a 24-hour period

II. Northbound Trips Pedestrians

Following the same methodology as in the previous section, the trip purpose distribution results were divided by place of residency, U.S., or Mexico. Also, the same trip purposes classification was applied to pedestrians' trips. Figures 4.11 and 4.12 show the results generated from the estimated weekday crossings over a 24-hour period by place of residency. As can be observed, the primary trip purposes for Mexican pedestrian travelers were work, education, shop, and recreational-related sites, with a slight variance of percentages by season and between seasons. Contrary to Mexican traveler's trip purposes, a pattern for the trip distribution of pedestrian U.S. residents was more challenging to identify since the percentages vary between seasons. However, it was possible to observe a regularity of high percentages for shopping, recreation, and health-related sites.

Compared to the northbound privately-owned vehicle trip purpose distribution by Mexican residents, higher percentages of educational-related site trips were reported under pedestrian trips. Considering that the additional estimated crossing percentages on pedestrian trip distribution (Figures 4.11 and 4.12) represent Santa Teresa northbound crossings due to the low number of trips reported, it can be assumed that the Stanton DCL crossings impacted the reported trip percentages for education trips.

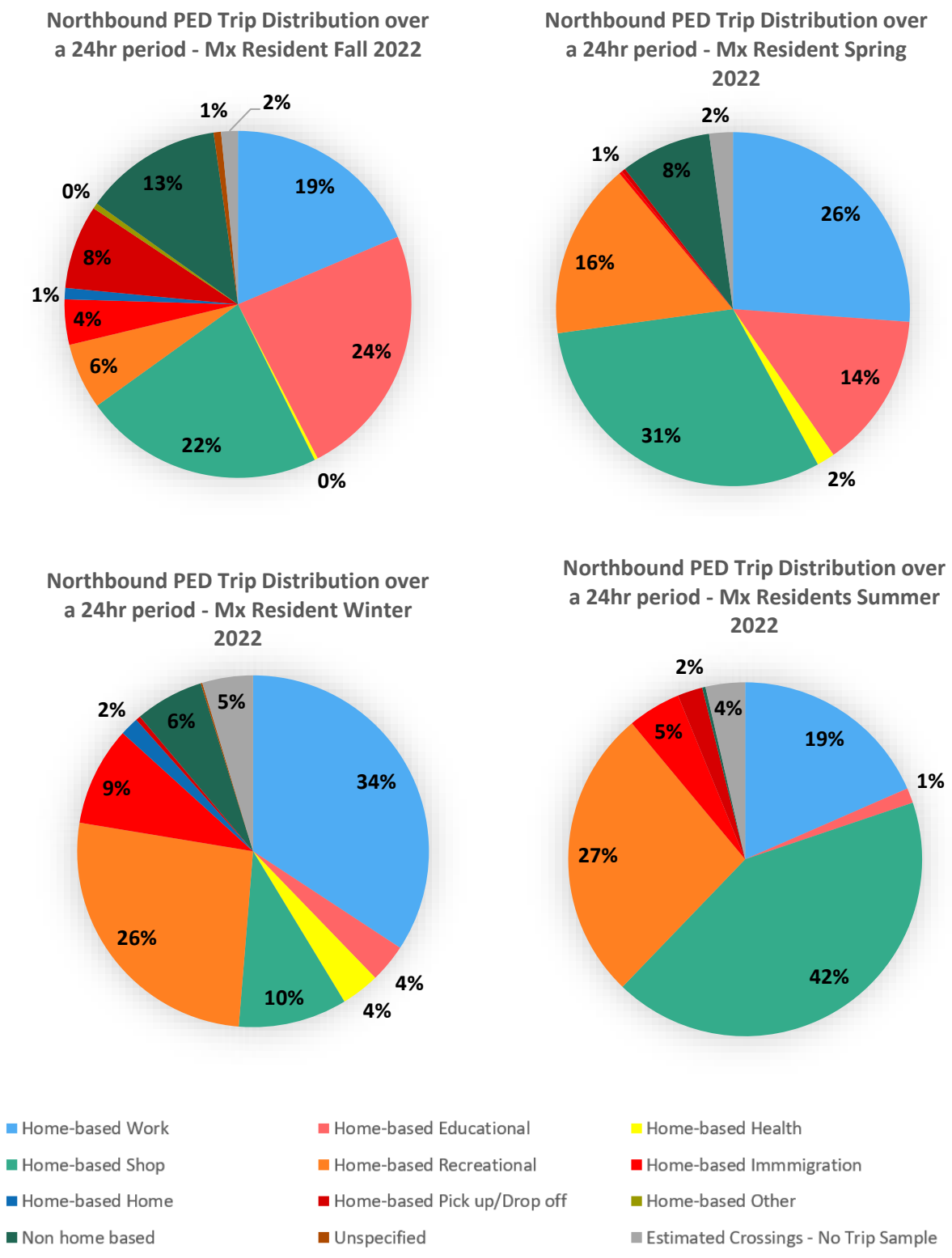

Figure 4.11. Estimated NB pedestrian trip purpose distribution by Mexican residents over a 24-hour period

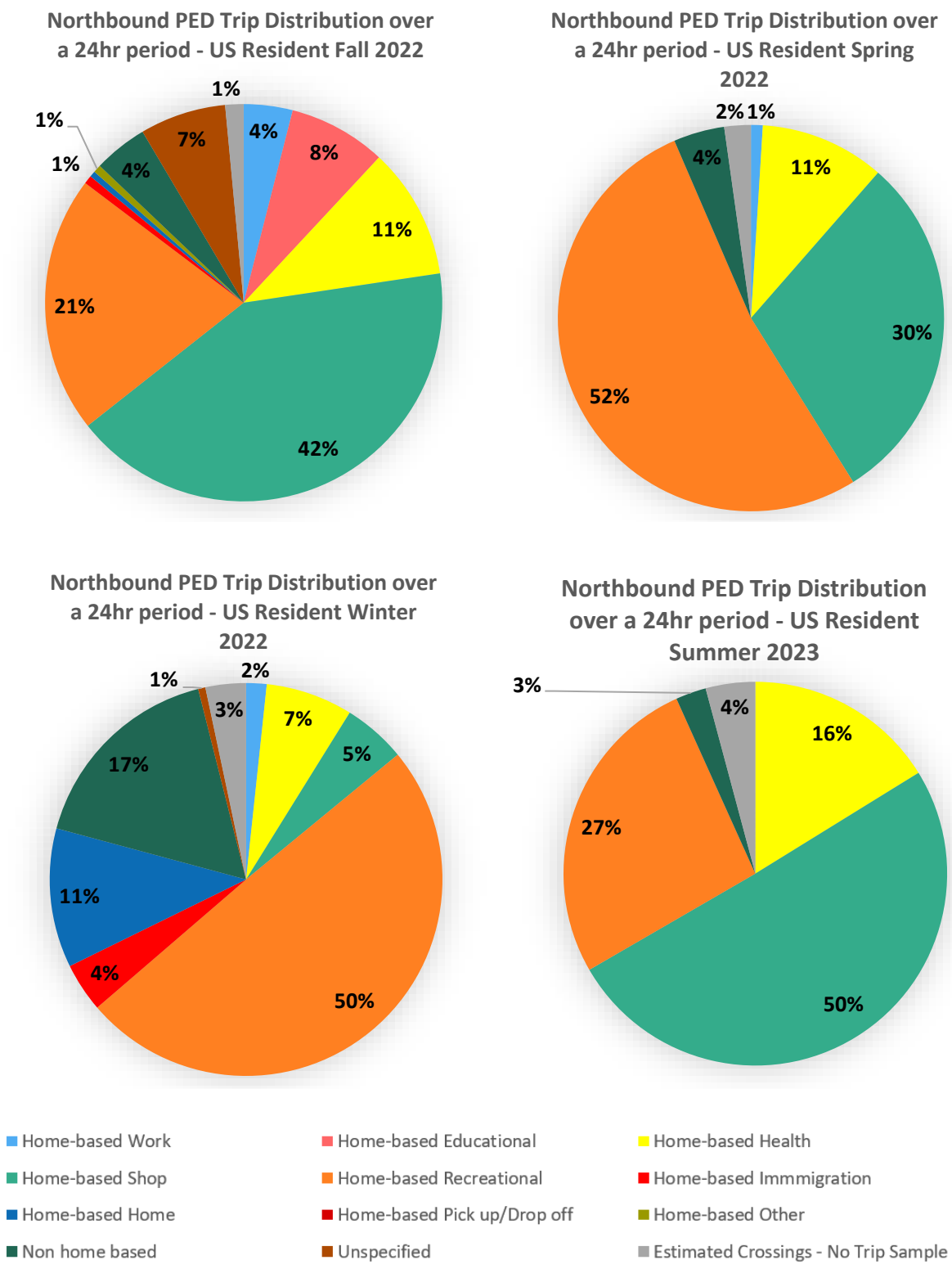

Figure 4.12. Estimated NB pedestrian trip purpose distribution by U.S. residents over a 24-hour period

III. Southbound Trips Privately-Owned Vehicles

For the estimated southbound trips of private-owned vehicles by Mexican travelers over 24 hours, the primary trip purposes were shopping, work, and educational purposes during Fall and Spring, which were school seasons. The primary trip purposes were shopping, recreation, and work during the off-school seasons, as shown in Figure 4.13. As shown in Figure 4.13, a higher percentage of educational trips were reported for southbound privately-owned vehicles compared to the percentage distribution of northbound trips. Considering that surveys were conducted at all IBCs at southbound privately-owned vehicle crossings, it was possible to report a more significant number of educational purposes than on northbound crossings, for which it was not considered the Stanton DCL travelers.

Figure 4.14 shows the trip purpose distribution of private-owned vehicles reported by US residents. As can be observed, U.S. residents' trip distribution varies between seasons, although recreational purposes and non-home-based trips were regularly the classifications with the highest percentages. The 18% of estimated crossings during Summer 2023 assumes the trips by U.S. residents on Ysleta since no trips were recovered from the sample that could be shown on the trip distribution.

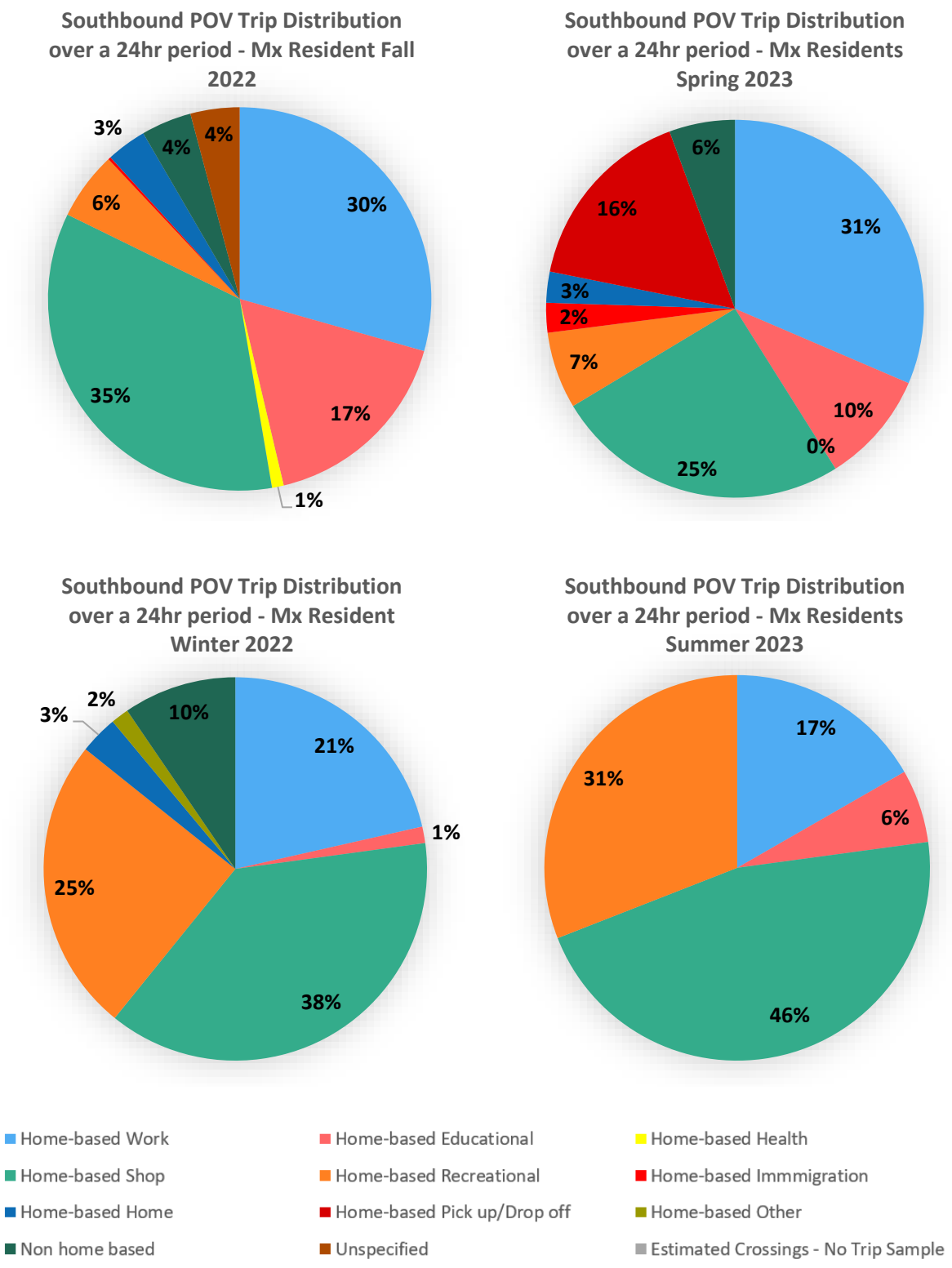

Figure 4.13. Estimated SB private-owned vehicles trip purpose distribution by Mexican residents over a 24-hour period

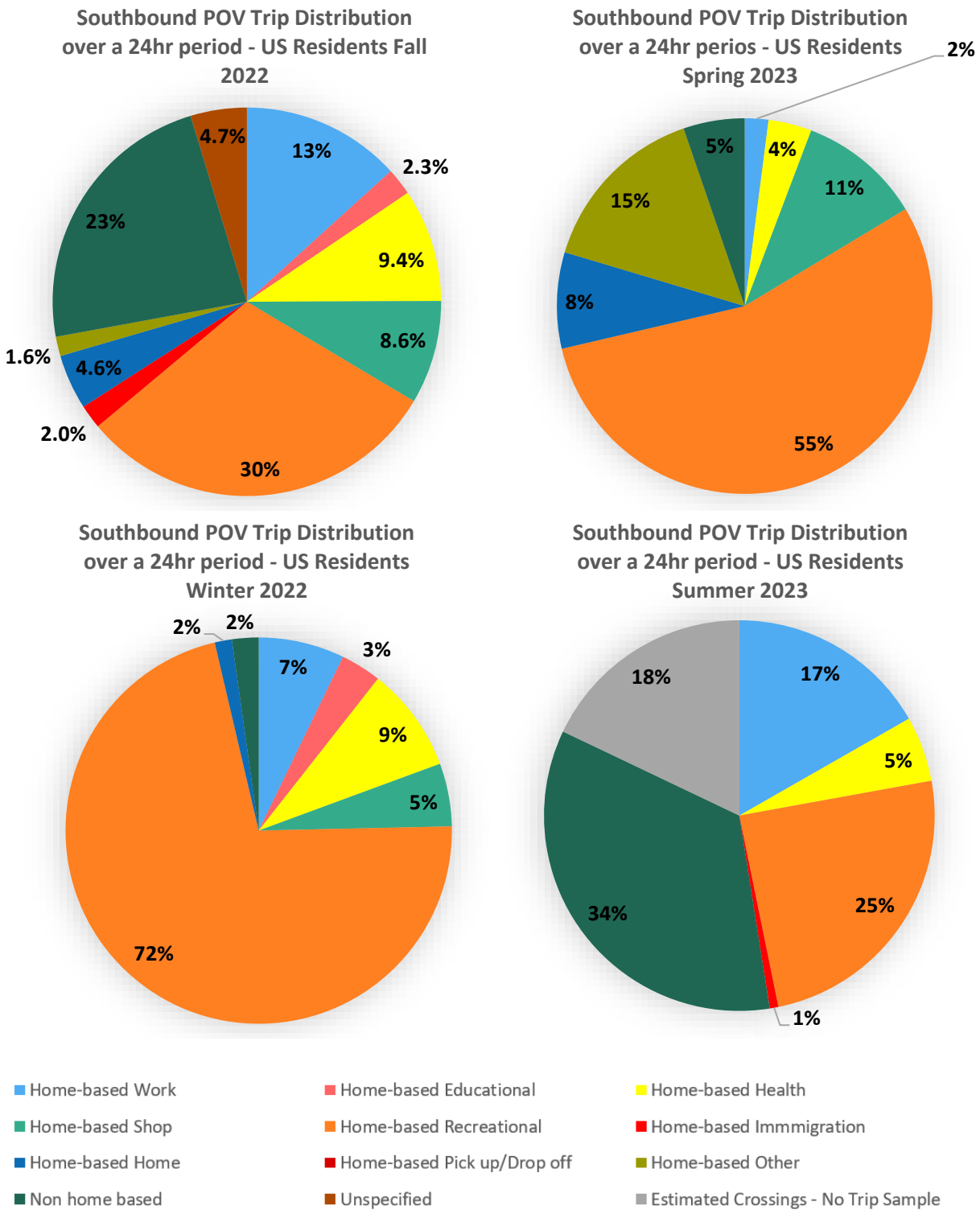

Figure 4.14. Estimated SB private-owned vehicles trip purpose distribution by U.S residents over a 24-hour period

IV. Southbound Trips Pedestrians

The last set of data analyzed under the trip classification used on previous results were the estimated weekday southbound trips for pedestrians crossing by U.S. and Mexican residents. As shown in Figure 4.15, Mexican residents' primary motives to cross were education, work, shopping, and recreational sites. For these results, the highest percentage of shopping trips occurred during the winter season, with 33% compared to the rest of the seasons. Compared to the rest of the results for all seasons, in this case, Mexican residents' trips during off-school season (Winter 2022 and Summer 2023) reported the closest trip purpose distribution between similar conditions periods. The primary motives to cross during off-school season were shopping, recreational, and work-related sites.

Trips by U.S. residents for southbound pedestrian crossings were the type of trips less reported on the field, and this is shown in Figure 4.16, where the estimated crossing with no trip sample distribution reports up to 49% of the estimated daily crossings on weekdays by U.S. residents. Aside from the estimated crossings with no trip sample, the highest percentages reported were for recreational purposes, with 30% and 32% trips estimated for Fall 2022 and Summer 2023, respectively.

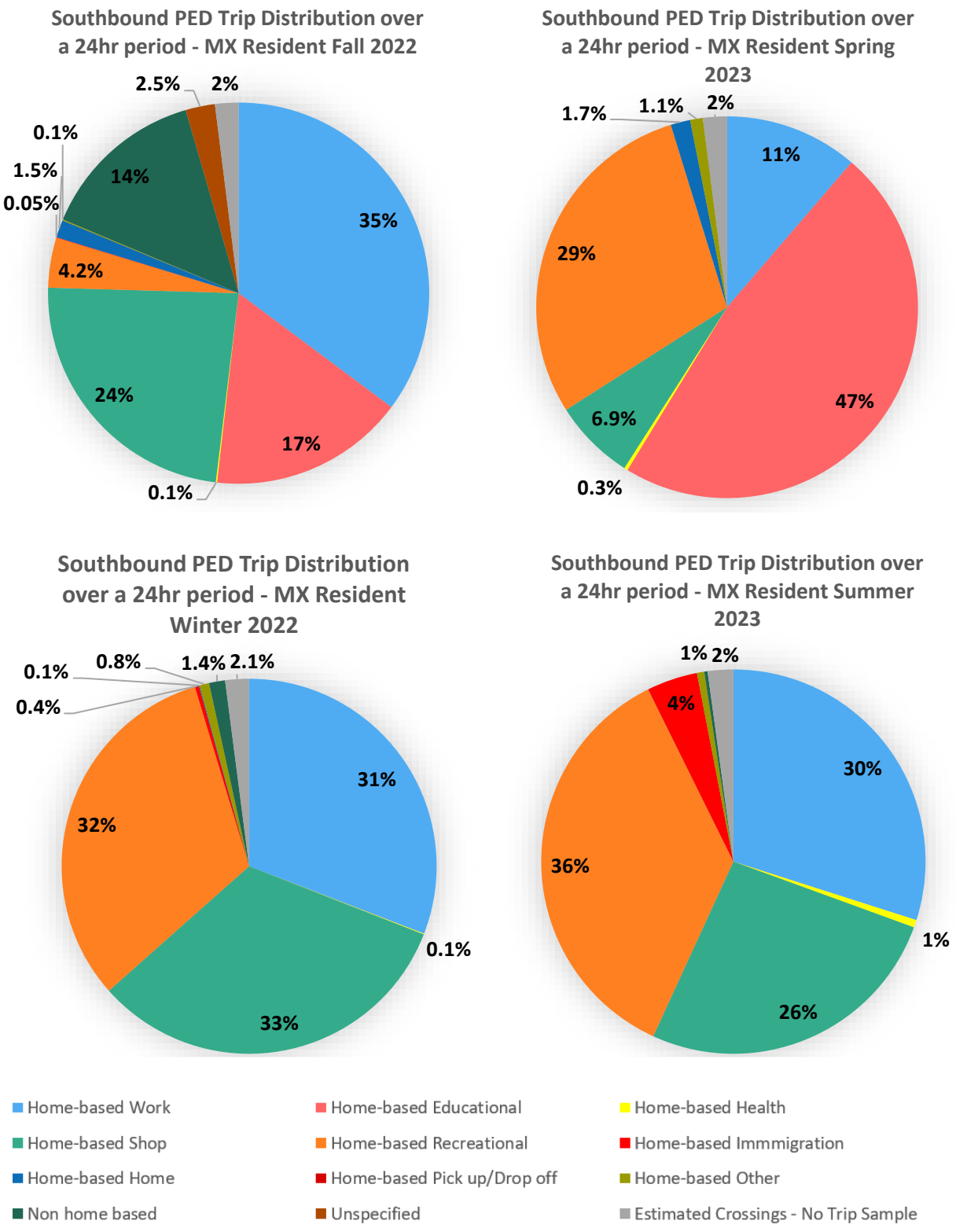

Figure 4.15 Estimated SB pedestrian trip purpose distribution by Mexican residents over a 24-hour period

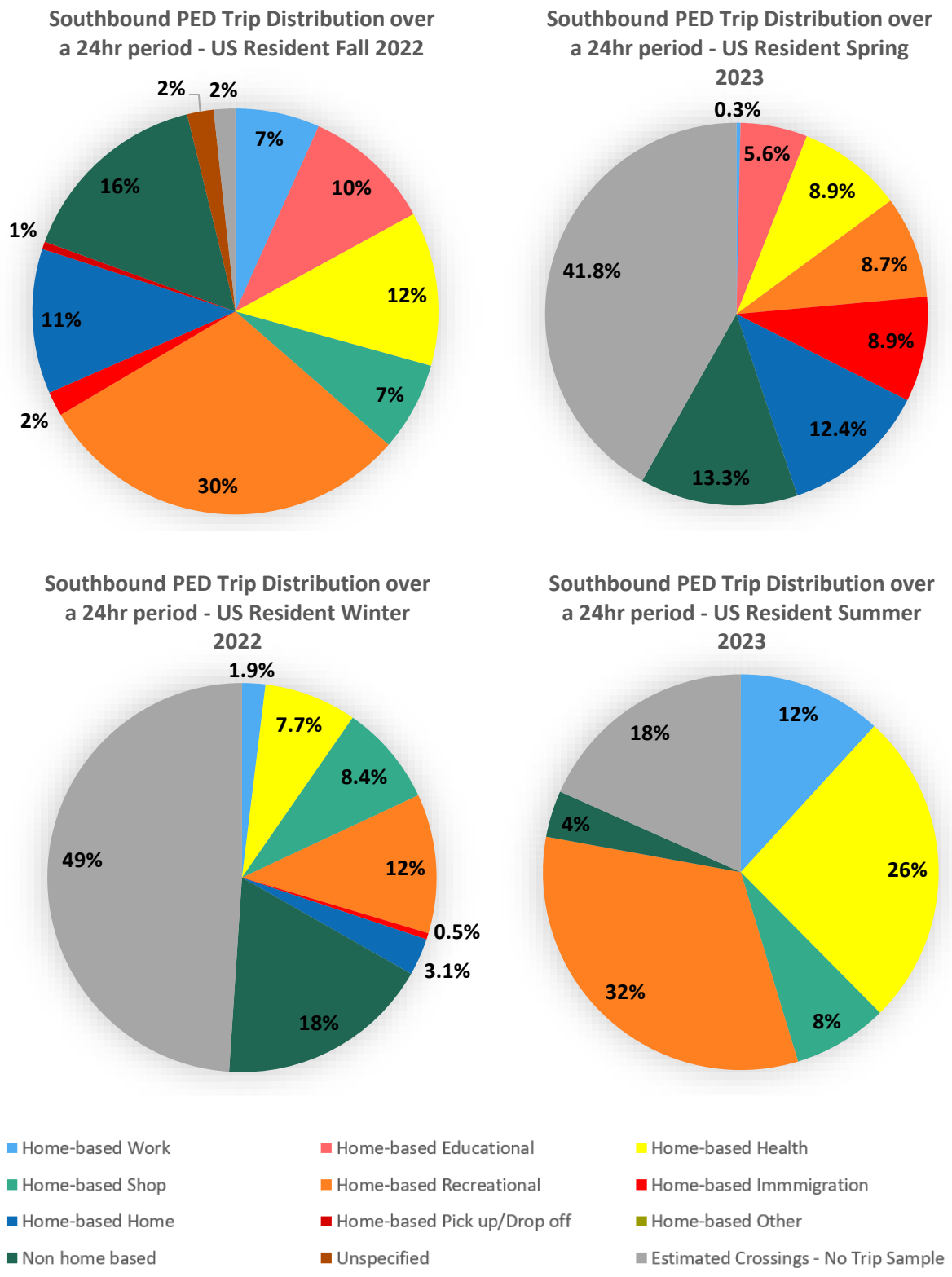

Figure 4.16 Estimated SB pedestrian trip purpose distribution by U.S. residents over a 24-hour period

4.1.3. Commercial Vehicles Trip Purpose Distribution

In the case of commercial truck trips, the classification of trip purposes was not the same as used for passenger vehicles or pedestrians. Following the classification methodology used by Aldrete et al (2023), in this study, the commercial trucks trip purposes were categorized by haul type and freight. Figure 4.17 shows the classification diagram defining the categories applied to this study. The haul was defined by the location of the trip ends reported by the respondent; if the trip was completed locally, meaning that both trip ends were inside the region of study, the trip was classified as drayage; if any of both trip ends were outside the study area, then the trip was classified as long-haul. After classifying the trip haul, it was necessary to classify the trip by freight, as shown in Figure 4.17. Following the Harmonized System code, freight was classified into manufactured goods, just-in-time or non-just-in-time, agricultural goods, nonperishables, and perishables. Any load type that could fit into these categories was classified as another.

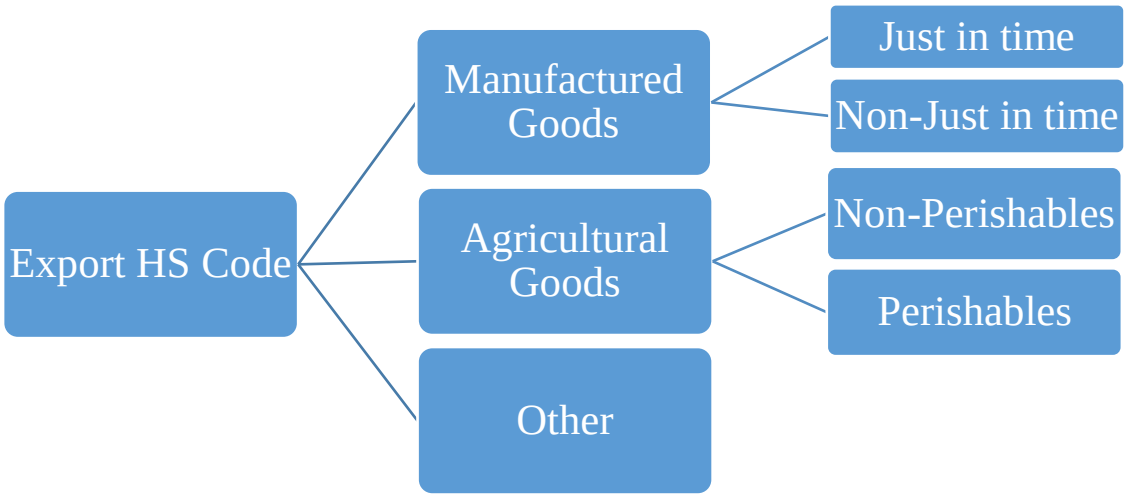

Figure 4.17, Commodity distribution Groups (Modified from Aldrete et al. 2023)

Figures 4.18 to 4.25 show the result obtained from the data analyzed on the estimated northbound and southbound commercial truck crossings over a 24-hour. As shown in the graphs, the highest number of estimated trips are classified as drayage, meaning most of the trips studied were completed within the areas of El Paso and Juarez. The international border crossing that reported long haul trips was Santa Teresa, which is located in New Mexico and allows the drivers to avoid the daily traffic of El Paso and Juarez.

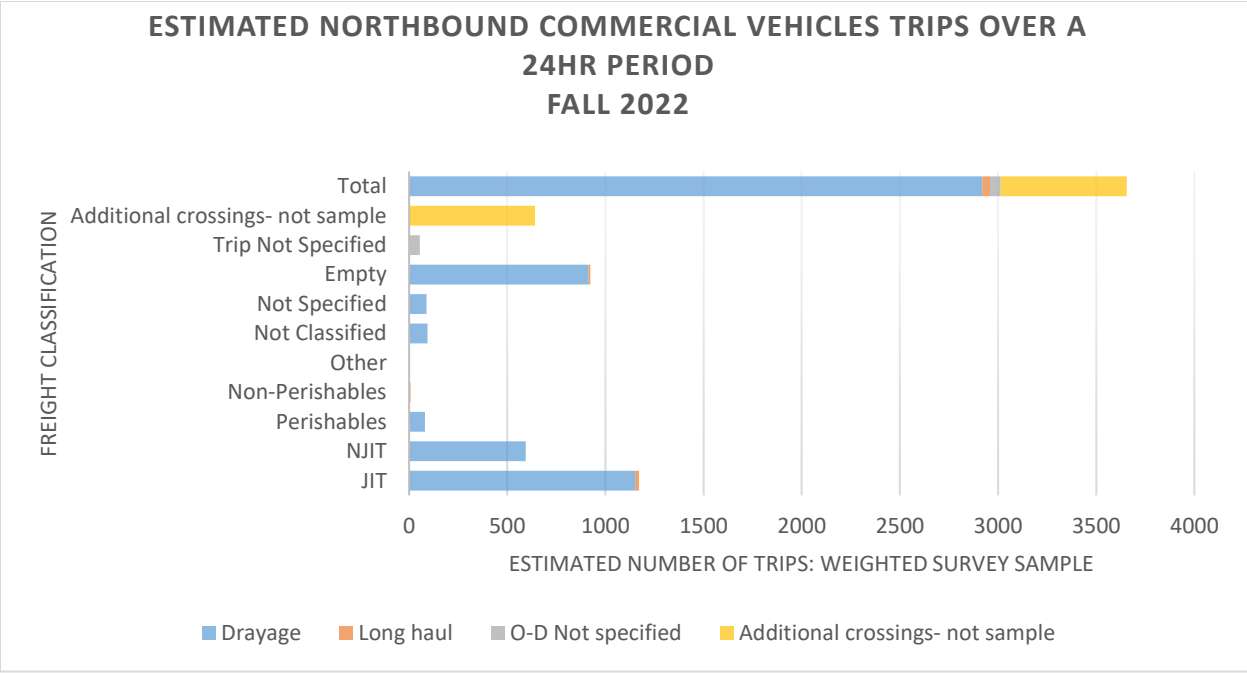

Figure 4.18. Northbound trip distribution during the first season

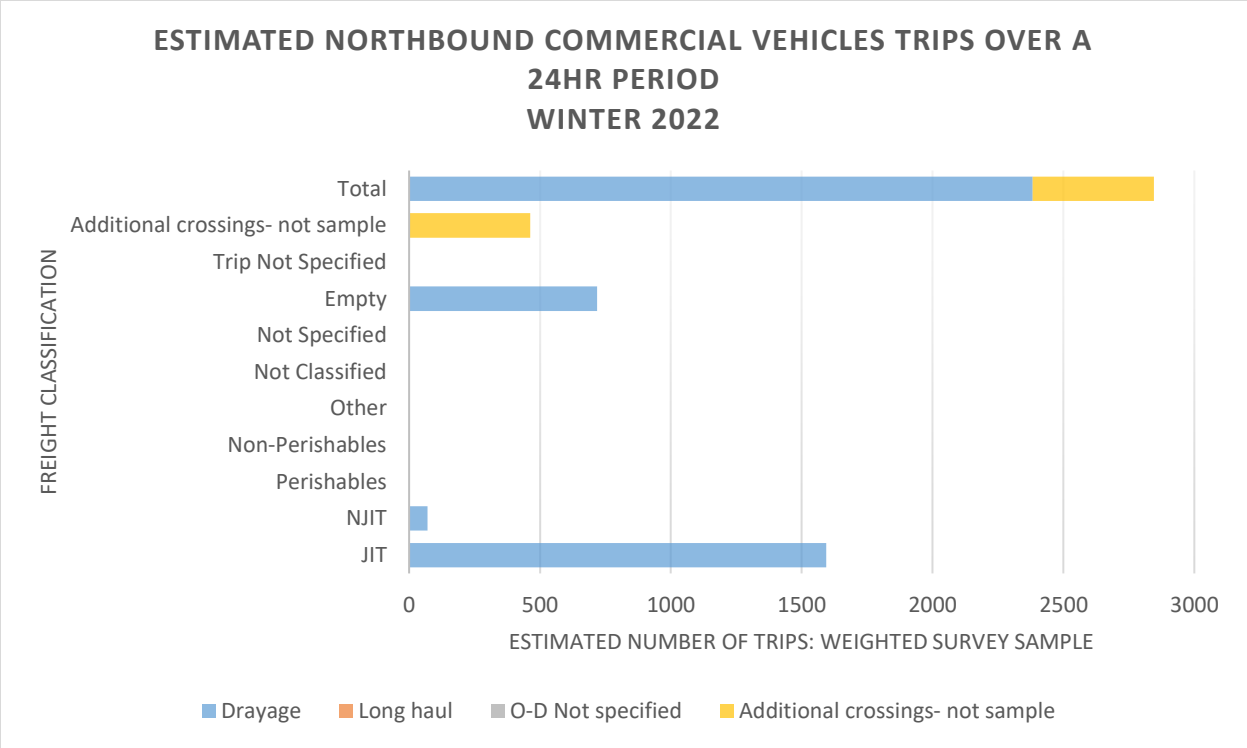

Figure 4.19. Northbound trip distribution during the second season

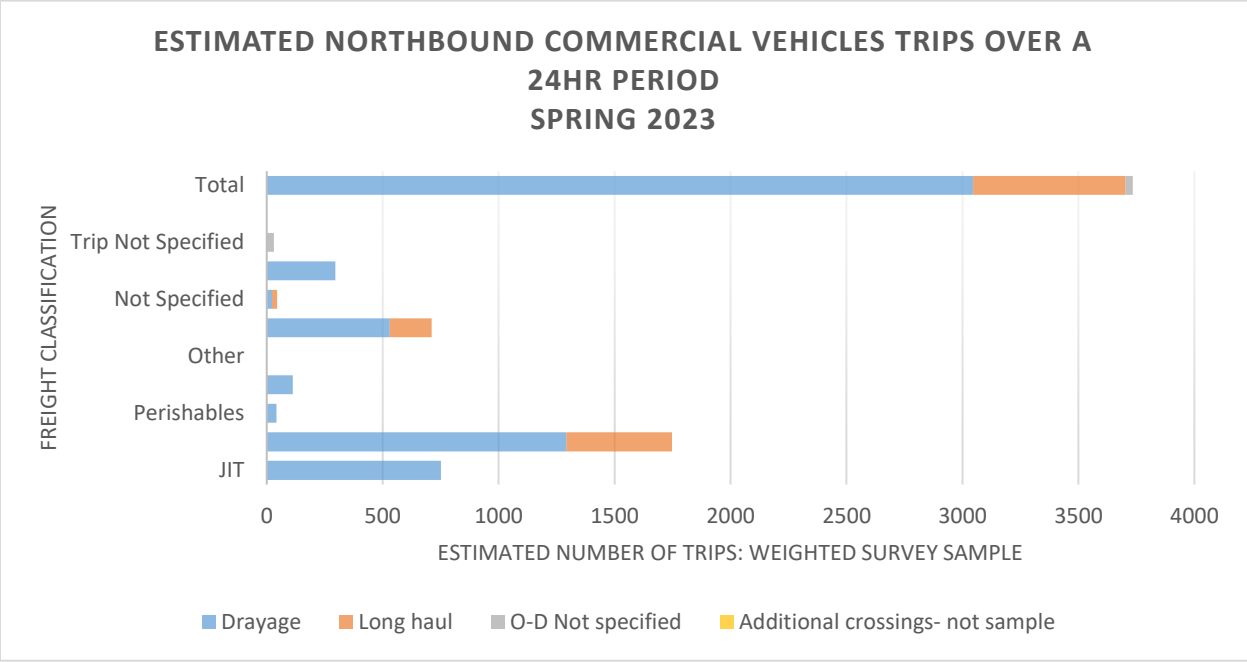

Figure 4.20. Northbound trip distribution during the third season

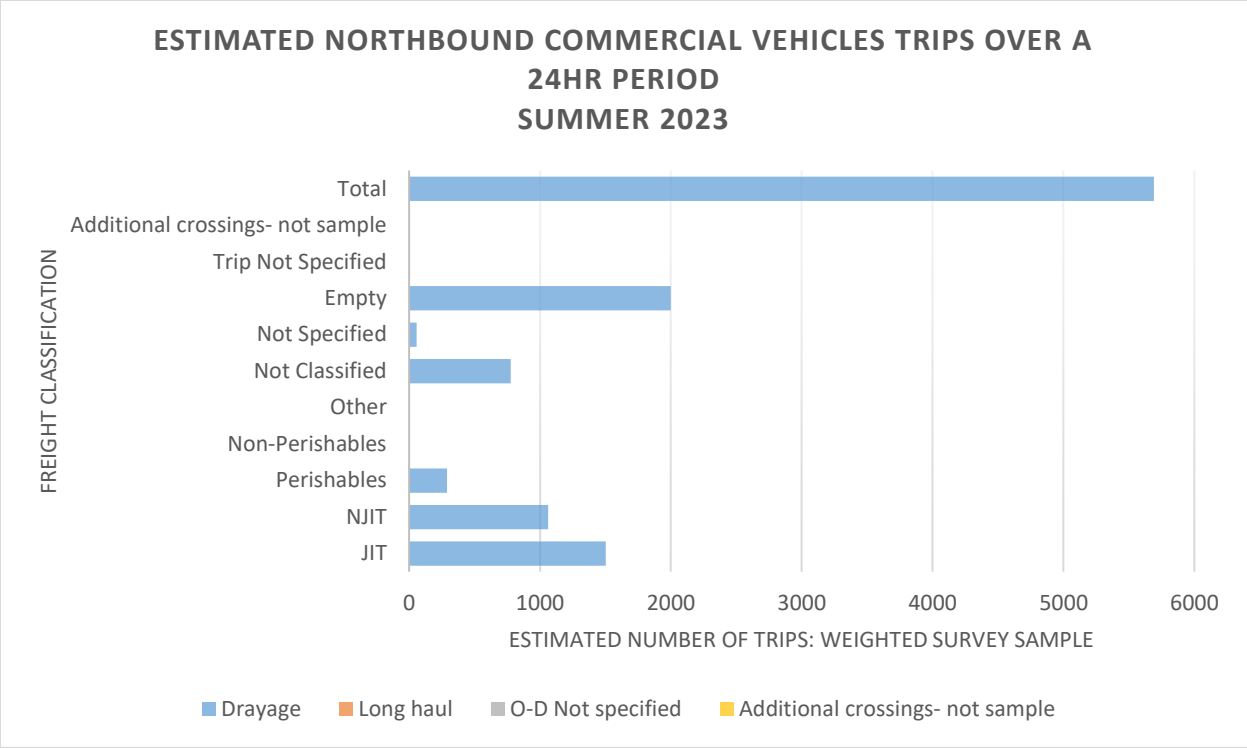

Figure 4.21. Northbound trip distribution during the fourth season

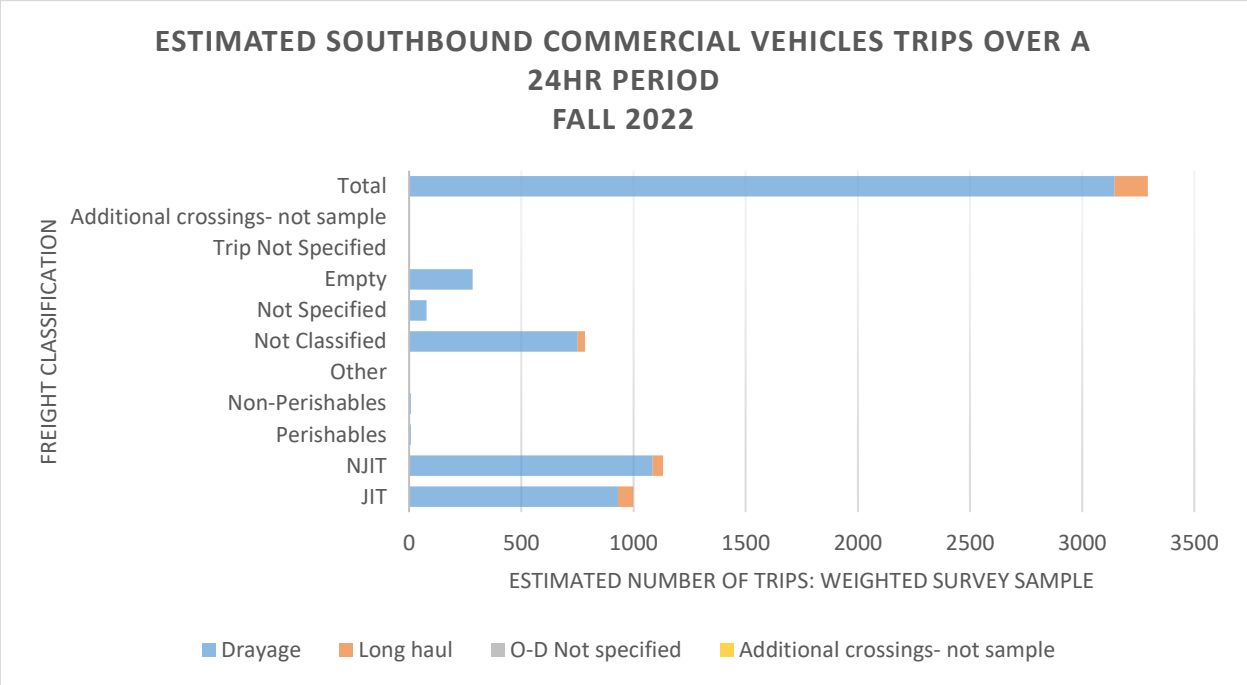

Figure 4.22. Southbound trip distribution during the first season

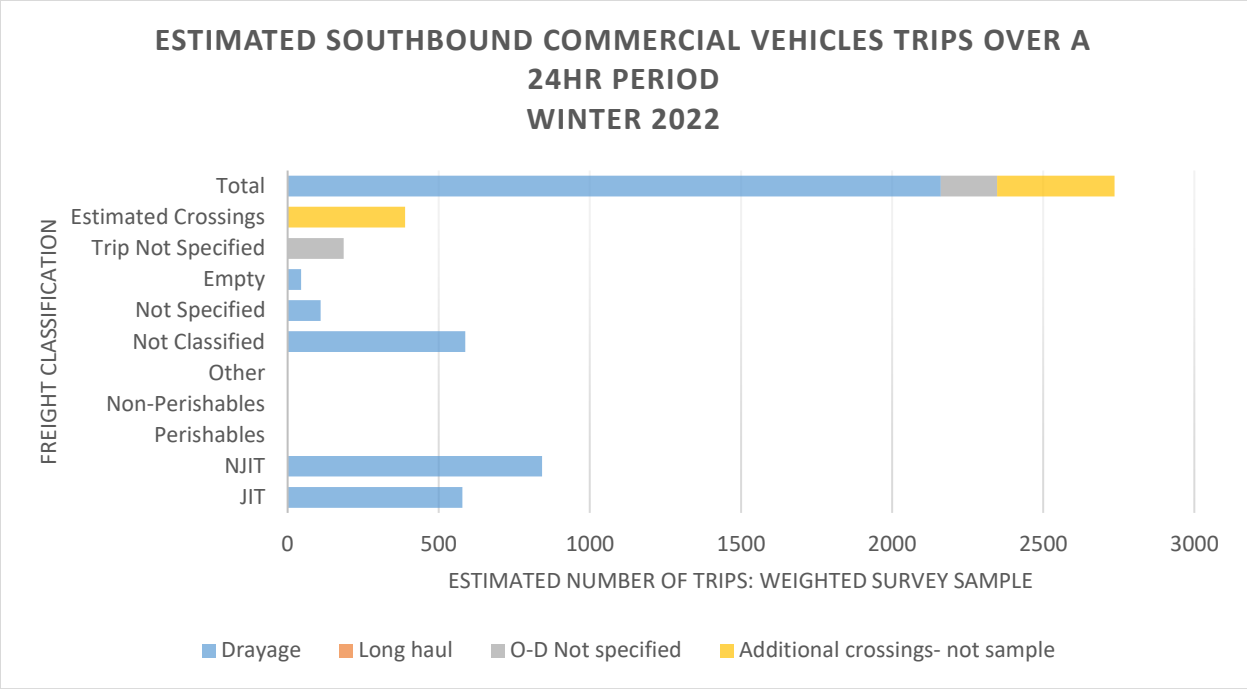

Figure 4.23. Southbound trip distribution during the second season

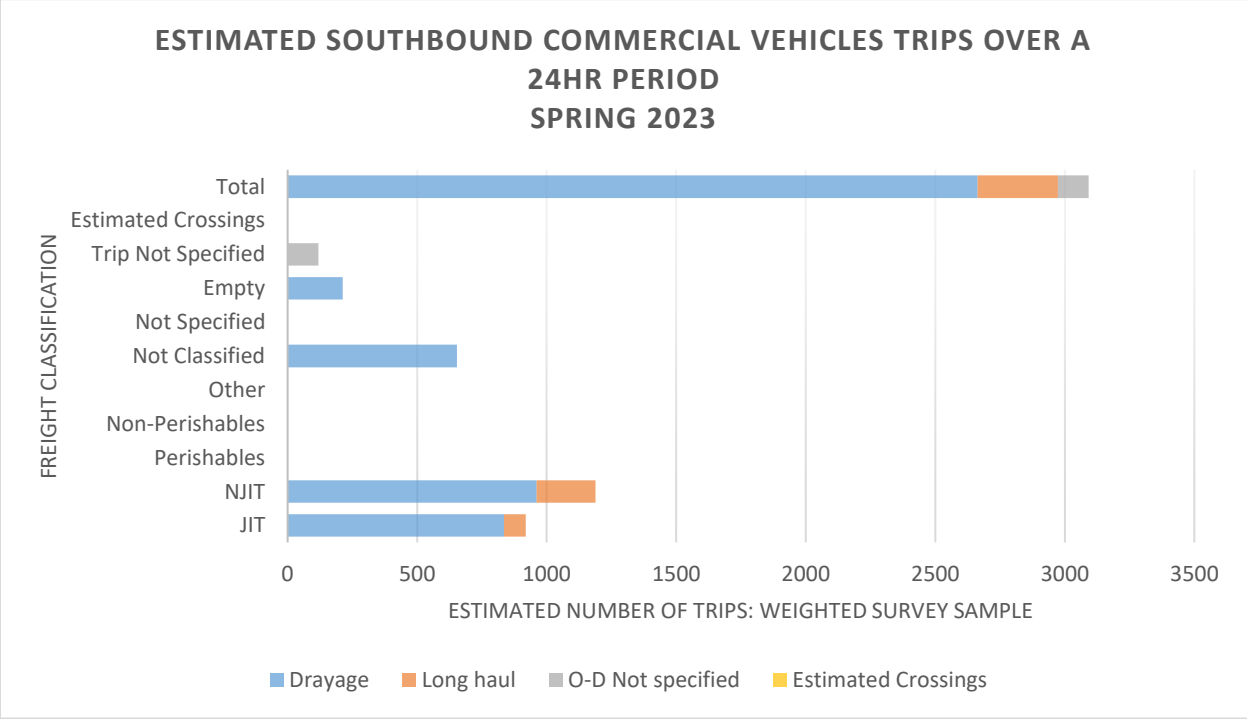

Figure 4.24. Southbound trip distribution during the third season

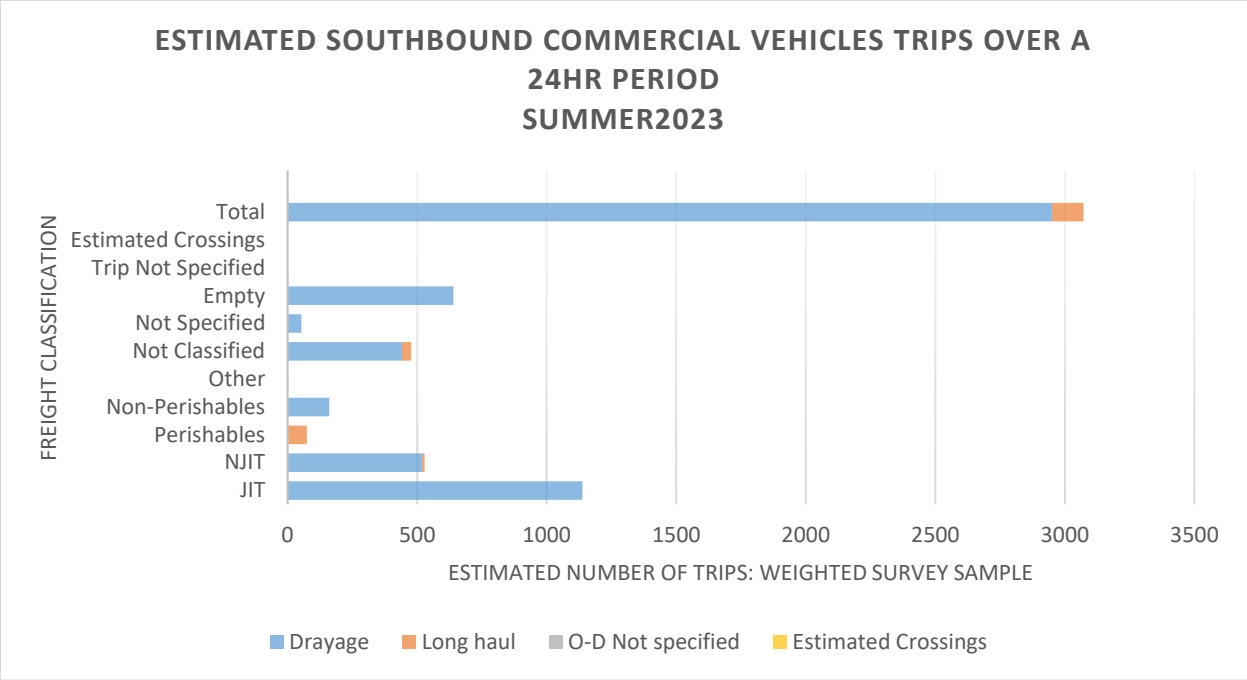

Figure 4.25 Southbound trip distribution during the fourth season

CHAPTER 5: CONCLUSION AND FUTURE WORK

5.1 Conclusion

This study provided an overview of the conventional methods used to collect trip information, with a high interest in studying the application in binational regions at international border crossings. Additionally, more recent methods and a case study application at binational regions, such as crowdsourced data, were studied. This study aimed to build on the existing studies of trip information collection at international border crossings by filling gaps in trip information. Based on the results obtained from the surveys, the following conclusions can be drawn:

- Mexican residents' trip distribution follows a more consistent pattern than U.S. residents. A leading cause of this could be the low number of travels reported by US residents compared to the number of trips reported by Mexican residents.
- From the estimated weekday trips by Mexican travelers, the primary trip purposes from the data analysis were shopping, work, and education-related sites.
- During the off-school season trips by Mexican travelers, purpose distribution increased on the recreational-related site purpose.
- The most regular crossing motives for privately owned vehicles and pedestrians by U.S residents were recreational, shopping, and health services.
- Even if this study covers a large scope area by including data collection at Santa Teresa POE, there are still areas that must be covered to capture the most accurate traveler's behavior/trip information. Such is the case with dedicated commuter lanes at Ysleta/Zaragoza and Stanton.
- Although data collection at DCL crossings can be challenging, other data collection methods can be studied and applied to collect data at these points., such as crowdsourced

data or passive collection data, which integrates new technologies to represent an average of 13% of daily northbound crossings that Stanton DCL represent.

- International jurisdiction terms, extreme weather conditions, and fast traffic flow at certain hours of the day are some of the challenges still present in the data collection of the trip information process.
- Multiple gaps exist in the data collection of border crossings, specifically on southbound trips.

5.2 Contributions

This study analyzes mobility behavior for privately owned vehicles and pedestrians in El Paso-Juarez region. However, additionally, it provides an analysis of the classification of commercial truck trips in the El Paso and Juarez regions. Previous reports review, under the literature section, shared methodologies on data collection for private-owned vehicles and pedestrians, in the majority conducted at northbound flow. Also, since the study was conducted to show the trips throughout the year's four seasons, it provides insight into the trip patterns between seasons and the changes in trip purposes during school and off-school seasons.

5.3 Future Work

Given the current study on trip mobility at the El Paso-Juarez region, this could be integrated into future work on studying potential scenarios using the international travel demand modeling and microsimulation models of the international border crossings. With the purpose to study the impact on congestion, air quality traffic demand, and delay at the IBCs.

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APPENDIX

Travel survey format: Passenger Vehicle

International border crossing travel survey Surveyor:____________________

Passenger Vehicle crossing to Juarez by: Date: ____/________/20__

[ ] Tornillo [ ]Zaragoza [ ]Américas [ ]Lerdo/Stanton ~~[ ]Santa Fe~~ [ ]Santa Teresa

	Passenger vehicle 1	Passenger vehicle 2	Passenger vehicle 3
1. Time	___:___am ___:___pm	___:___am ___:___pm	___:___am ___:___pm
2. Number of passengers in the vehicle (including driver)			
3. Vehicle type	[ ] car [ ] taxi [ ] moto [ ] pick-up [ ] van [ ] other____________	[ ] car [ ] taxi [ ] moto [ ] pick-up [ ] van [ ] other____________	[ ] car [ ] taxi [ ] moto [ ] pick-up [ ] van [ ] other____________
4.In what city and state do you live?	[ ] Cd. Juárez [ ] El Paso [ ] other:______________ city / state	[ ] Cd. Juárez [ ] El Paso [ ] other:______________ city / state	[ ] Cd. Juárez [ ] El Paso [ ] other:______________ city / state
5. Last place where you got into your vehicle (nearest street intersection/place and city)			
5a. At what time did you leave this place?	___:___am ___:___pm	___:___am ___:___pm	___:___am ___:___pm
5b. What was the purpose of this trip?	[ ] home [ ] work / work related [ ] school [ ] medical services [ ] social/entretainment/vacations [ ] shopping/eating out/gasoline [ ] Drop off or pick up someone [ ] other____________	[ ] home [ ] work / work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/ eating out/ gasoline [ ] Drop off or pick up someone [ ] other____________	[ ] home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/ eating out/ gasoline [ ] Drop off or pick up someone [ ] other____________
6. ¿What is your next destination? (nearest street intersection/place and city)			
6b. ¿What is the purpose of this trip?	[ ] home/ back home [ ] work/ work related [ ] school [ ] medical services [ ] social/entretainment/vacations [ ] shopping/eating out/ gasoline [ ] Leave or pick up someone [ ] other____________	[ ] home / back home [ ] work/ work related [ ] school [ ] medical services [ ] social/entretainment/ vacations [ ] shopping/eating out/gasoline [ ] Leave or pick up someone [ ] other____________	[ ] home/ back home [ ] work/ work related [ ] school [ ] medical services [ ] social/entretainment/ vacations [ ] shopping/eating out/gasoline [ ] Leave or pick up someone [ ] other____________
7.To measure the number of trips you have made, we need to know what places you've visited today :			
7a. Where did your fisrt trip started? (nearest street intersection/place and city)			
7b. From that place, what was your next destination? (nearest street intersection/place and city)			
7c. Where did you go next? (nearest street intersection/place and city)			
7d. Where did you go next? (nearest street intersection/place and city)			
7e. Where did you go next? (nearest street intersection/place and city)			
7f. Where did you go next? (nearest street intersection/place and city)			
7g. How many other places did you stop at today?			
8. Household montly income	$ ________ dollars/month	$ ________ dollars/month	$ ________ dollars/month
9. Including yourself, how many people live in you house	______people	______people	______people
Mexican Residents only: 10a.How much did you spend in US today? (shopping, medical, gasoline, banking.)	$__________dollars	$__________dollars	$__________dollars/month
10b. Wait time spent in lane to cross to USA today	__:___ (hr : min) walking [ ]Yes [ ]No DCL (vehicle) [ ]Yes [ ]No	__:___ (hr : min) walking [ ]Yes [ ]No DCL (vehicle) [ ]Yes [ ]No	__:___ (hr : min) walking [ ]Yes [ ]No DCL (vehicle) [ ]Yes [ ]No
10c We want to know how much need you had TODAY to cross into the U.S. Indicate if TODAY you would have crossed to the U.S., knowing in advance that the time expected waiting time: (ask every hour, international bridge, and mode)	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No

Travel survey format: Pedestrians

International border crossing travel survey

Surveyor:____________________

Pedestrian crossing to Juarez by:

Date: ____/________/20__

[ ] Tornillo [ ]Zaragoza [ ]Américas [ ]Lerdo/Stanton [ ]Santa Fe [ ]Santa Teresa

	veh de PASAJEROS 1		
1. Time	___:___am ___:___pm	___:___am ___:___pm	___:___am ___:___pm
2. In what city and state do you live?	[ ] Cd. Juárez [ ] El Paso [ ] other:____________________ city / state	[ ] Cd. Juárez [ ] El Paso [ ] other:____________________ city / state	[ ] Cd. Juárez [ ] El Paso [ ] other:____________________ city / state
3. ¿What was the last place you visited before coming here? (nearest street intersection/place and city)			
3a. At what time did you leave this place?	___:___am ___:___pm	___:___am ___:___pm	___:___am ___:___pm
3b. What was the purpose of this trip?	[ ] home [ ] work/work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/resataurants/gasoline [ ] Leave or pick up someone [ ] other_______________	[ ] home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/restaurants/gasoline [ ] Leave or pick up somenone [ ] other_______________	[ ] home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/restaurants/gasoline [ ] Leave or pick up someone [ ] other_______________
3c. From that place, how did you arrive to this international bridge?	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc
4. What is your next destination? (nearest street intersection/place and city)			
4b. What was the purpose of this trip?	[ ] home/ returning home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/eating out/gasoline [ ] Leave or pick up someone [ ] other_______________	[ ] home/ returning home [ ] work./ work related [ ] school [ ] medical services [ ] social/entertainment/ vacations [ ] shopping/eating out/ gasoline [ ] Leave or pick up someone [ ] other_______________	[ ] home/ returning home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/eating out/ vacations [ ] Leave or pick up someone [ ] other_______________
4c. What trasnportaion mode will you use to go to your next destination?	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc
5. To measure the number of trips you have made, we need to know what places you've visited today :			
5a. Where did your fisrt trip started? (nearest street intersection/place and city)			
5b. From that place, what was your next destination? (nearest street intersection/place and city)			
5c. Where did you go next? (nearest street intersection/place and city)			
5d. Where did you go next? (nearest street intersection/place and city)			
5e. Where did you go next? (nearest street intersection/place and city)			
5f. Where did you go next? (nearest street intersection/place and city)			
5g. How many other places did you stop at today?			
6. Household montly income	$__________dollars/month	$__________dollars/month	$__________dollars/month
7. Including yourself, how many people live in you household?	_____people	_____people	_____people
Mexican Residents Only 8a.How much did you spend in US today? (shopping, gasoline, banking, medical services, etc.)	$__________dollars	$__________dollars	$__________dollars
8b Wait time spent in lane to cross to USA today	__:__ cruzó a pie [ ]Yes [ ]No (hr : min) DCL (auto) [ ]Yes [ ]No	__:__ cruzó a pie [ ]Yes [ ]No (hr : min) DCL (auto) [ ]Yes [ ]No	__:__ cruzó a pie [ ]Yes [ ]No (hr : min) DCL (auto) [ ]Yes [ ]No
8c.We want to know how much need you had TODAY to cross into the U.S. Indicate if TODAY you would have crossed to the U.S., knowing in advance the expected waiting time (ask every hour, international bridge, and mode)	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No

Travel survey format: Commercial Trucks

International border crossing travel survey

Surveyor:_____

Cargo Vehicle crossing to Juarez by:

Date: ____/_____/20__

[ ] Tornillo [ ]Zaragoza [ ]Américas ~~[ ]Lerdo/Stanton~~ ~~[ ]Santa Fe~~ [ ]Santa Teresa

	veh de CARGA 1	veh de CARGA 2	veh de CARGA 3
1. Time	____:____am ____:____pm	____:____am ____:____pm	____:____am ____:____pm
2. Number of people in the vehicle			
3. Vehicle classification (Vehicle code)			
4. Cargo type (Cargo code)	_____ [ ]empty cargo	_____ [ ]empty cargo	_____ [ ]empty cargo
5. ¿Where did you pick up the shipment? (nearest street intercetion/ place)			
6. ¿Was this place an intermodel station or a custom broker?	[ ] Yes [ ] No [ ] not sure/refuse to say	[ ] Yes [ ] No [ ] not sure/refuse to say	[ ] Yes [ ] No [ ] not sure/refuse to say
7. How was cargo tranferred at the location? (Transfer code)			
8. Where would you leave the cargo? (nearest street intercetion/ place)			
9. Is the place a intermodel transfer station or a custom broker?	[ ] Yes [ ] No [ ] not sure/refuse to say	[ ] Yes [ ] No [ ] not sure/refuse to say	[ ] Yes [ ] No [ ] not sure/refuse to say
10. How will the load be transferred at that location? (Transfer classification)			
11. Last place where you got into the vehicle (nearest street intercetion/ place)			
11a. At what time did you leave the place??	____:____am ____:____pm	____:____am ____:____pm	____:____am ____:____pm
11b. What type of place it was? (PLACE code)			
11c. What was your trip purpose? (PURPOSE code)			
12. What is your next destination? (nearest street intercetion/ place)			
16a. What was the prupose for going to this place? (PURPOSE code)			

To measure the number of trips you have made, we need to know what places you've visited today :

13. Where did you first trip started today? (nearest place/ubication/ city)			
14. Where did you go from there? (nearest place/ubication/ city)			
15.Where did you go next? (nearest place/ubication/ city)			
16. Where did you go next? (nearest place/ubication/ city)			
17.Where did you go next? (nearest place/ubication/ city)			
18. Where did you go next? (nearest place/ubication/ city)			
19. Where did you go next? (nearest place/ubication/ city)			
20. How many other places did you stop at today?			

Vehicle classification

1. auto/pick-up/van	
2. Two axle single unit (6 tires)	
3. Three axle single unit (10 tires)	
4. Four axle unit (14 tires)	
5. tractor-trailer	 …or larger cvehicle type (more axles, double unit, etc.)

código CARGA	incluye
1 . Productos de granjas	Ganado, fertilizantes, tierra, etc
2 . Productos forestales	Arboles, etc
3 . Productos marinos	Pescado fresco, mariscos, etc
4 . Metales y minerales	Petróleo crudo, gas natural, propano, metales, etc.
5 . Productos alimenticios, de salud, y de belleza	Productos alimenticios, medicamentos, cosméticos, etc
6 . Productos de tabaco	Cigarros, puros, tabaco de mascar, etc
7 . Textiles	Ropa, telas, etc.
8 . Productos de madera	Maderas, papel, cartón, pulpa de madera, etc.
9 . Productos de imprenta	Periódicos, revistas, libros, etc
10 . Productos químicos	Jabones, pinturas, químicos domésticos o industriales, etc.
11 . Comustibles de petróleo	Gasolinas, diesel, etc.
12 . Productos plásticos, de hule y de estayrofoam	Productos terminados de plástico, hule y estayrofoam.
13 . Arcillas, concretos, piedras, vidrio	Productos terminados de arcilla, concreto, piedra y vidrio.
14 . Bienes y equipos manufacturados	Maquinaria, aparatos domésticos, muebles, etc.
15 . Desechos	Desechos y materiales reciclables.
16 . Paquetería y correo	UPS, FedEx, DHL, Servicio Postal Mexicano, etc.
17 . Materiales peligrosos	Químicos y sustancias de alto riesgo.
18 . Productos de transporte	Automóviles, motocicletas, vehículos pesados, etc
19 . Carga sin clasificar	Carga no incluida en esta clasificación
20 . Chofer rehusa contestar	Chofer rehusa indicar contenido de carga.
21 . Desconocido a chofer	Chofer desconoce contenido de carga.
22 . Vacío	Vacío (incluyendo carga de contenedores vacíos)

código TRANSFER

1. entre Camión y Camión
2. entre Ferrocarril y Camión
3. entre Barco y Camión
4. entre Avión y Camión
5. entre Bodega y Camión
6. entre Ducto (oleo-, gaso-, etc) y Camión
7. No sabe

código PROPOSITO

1. sitio base /regresar a sitio base
2. entregar carga
3. recoger caraga
4. mantenimiento
5. necesidades del chofer (tomar alimentos, etc)
6. al hogar
7. Poner combustible
8. No sabe

código LUGAR

1. Edificio oficinas	7. Residencial
2. Comercio	8. Aeropuerto
3. Industrial /Manufactura /Bodega	9. Establecimiento de comida
4. Médico	10. Hotel /Motel
5. Centro educativo	11. Otro (especificar)
6. Gobierno	12. No sabe

APPENDIX

Table 1. Commodity Distribution Using H.S. Chapter Codes

2- Digit Commodity Code	Commodity Description	DCET Group
84	Nuclear reactors, boilers, machinery, and mechanical appliances; parts thereof	**Just-in-time**
85	Electrical machinery and equipment and parts thereof; Sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles	
86	Railway or tramway locomotives, rolling stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; Mechanical (including electromechanical) traffic signaling equipment of all kinds	
87	Vehicles, other than railway or tramway rolling stock, and parts and accessories thereof	
88	Aircraft, spacecraft, and parts thereof	
89	Ships, boats, and floating structures	
90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; Parts and accessories thereof	
93	Arms and ammunition; Parts and accessories thereof	
28	Inorganic chemicals; Organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes	**Non-just-in-time**
29	Organic chemicals	
30	Pharmaceutical products	
31	Fertilizers	
32	Tanning or dyeing extracts; Tannins and their derivatives; Dyes, pigments and other coloring matter; Paints and varnishes; Putty and other mastics; Inks	
33	Essential oils and resinoids; Perfumery, cosmetic or toilet preparations	
34	Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes, prepared waxes, polishing or scouring preparations, candles and similar articles, modeling pastes, dental waxes and dental preparations with a basis of plaster	
35	Albuminoidal substances; Modified starches; Glues; Enzymes	

36	Explosives; Pyrotechnic products; Matches; Pyrophoric alloys; Certain combustible preparations	
37	Photographic or cinematographic goods	
38	Miscellaneous chemical products	
39	Plastics and articles thereof	
40	Rubber and articles thereof	
41	Raw hides and skins (other than furskins) and leather	
42	Articles of leather; Saddlery and harness; Travel goods, handbags and similar containers; Articles of animal gut (other than silkworm gut)	
43	Furskins and artificial fur; Manufactures thereof	
44	Wood and articles of wood; Wood charcoal	
45	Cork and articles of cork	
46	Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork	
47	Pulp of wood or of other fibrous cellulosic material; Waste and scrap of paper or paperboard	
48	Paper and paperboard; Articles of paper pulp, of paper or of paperboard	
49	Printed books, newspapers, pictures, and other products of the printing industry; Manuscripts, typescripts, and plans	
50	Silk	
51	Wool, fine or coarse animal hair; Horsehair yarn and woven fabric	
52	Cotton	
53	Other vegetable textile fibers; Paper yarn and woven fabrics of paper yarn	
54	Man-made filaments	
55	Man-made staple fibers	
56	Wadding, felt and nonwovens; Special yarns; Twine, cordage, ropes and cables and articles thereof	
57	Carpets and other textile floor coverings	
58	Special woven fabrics; Tuffed textile fabrics; Lace; Tapestries; Trimmings; Embroidery	
59	Impregnated, coated, covered or laminated textile fabrics; Textile articles of a kind suitable for industrial use	
60	Knitted or crocheted fabrics	
61	Articles of apparel and clothing accessories, knitted or crocheted	
62	Articles of apparel and clothing accessories, not knitted or crocheted	
63	Other made-up textile articles; Needle craft sets; Worn clothing and worn textile articles; rags	

64	Footwear, gaiters and the like; Parts of such articles	
65	Headgear and parts thereof	
66	Umbrellas, sun umbrellas, walking sticks, seatsticks, whips, riding crops and parts thereof	
67	Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair	
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	
69	Ceramic products	
70	Glass and glassware	
71	Natural or cultured pearls, precious or semiprecious stones, precious metals; metals clad with precious metal, and articles thereof; imitation jewelry; coin	
72	Iron and steel	
73	Articles of iron or steel	
74	Copper and articles thereof	
75	Nickel and articles thereof	
76	Aluminum and articles thereof	
78	Lead and articles thereof	
79	Zinc and articles thereof	
80	Tin and articles thereof	
81	Other base metals; Cements; Articles thereof	
82	Tools, implements, cutlery, spoons, and forks of base metal; Parts thereof of base metal	
83	Miscellaneous articles of base metal	
91	Clocks and watches and parts thereof	
92	Musical instruments; Parts and accessories of such articles	
94	Furniture; Bedding, mattress supports, cushions, and similar stuffed furnishings; Lamps and lighting fittings, not elsewhere specified or included; Illuminated signs, illuminated nameplates, and the like; Prefabricated buildings	
95	Toys, games, and sports equipment; Parts and accessories thereof	
96	Miscellaneous manufactured articles	
01	Live animals	**Perishables**
02	Meat and edible meat offal	
03	Fish and crustaceans, mollusks, and other aquatic invertebrates	
04	Dairy produce; Birds' eggs; Natural honey; Edible products of animal origin, not elsewhere specified or included.	

05	Products of animal origin not elsewhere specified or included.	
06	Live trees and other plants; Bulbs, roots, and the like; Cut flowers and ornamental foliage	
07	Edible vegetables and certain roots and tubers	
08	Edible fruit and nuts; Peel of citrus fruit or melons	
11	Products of the milling industry; Malt, Starches, inulin, Wheat gluten	
16	Preparations of meat, fish, crustaceans, mollusks or other aquatic invertebrates	
19	Preparations of cereals, flour, starch, or milk; Bakers' wares	
20	Preparations of vegetables, fruit, nuts, or other parts of plants	
09	Coffee, tea, mate, and spices	**Nonperishables**
10	Cereals	
12	Oil seeds and oleaginous fruits; Miscellaneous grains; Seeds and fruit; Industrial or medicinal plants; Straw and fodder	
13	Lac; Gums; Resins and other vegetable saps and extract	
14	Vegetable plaiting materials; Vegetable products not elsewhere specified or included	
15	Animal or vegetable fats and oils and their cleavage products; Prepared edible fats; Animal or vegetable waxes	
17	Sugars and sugar confectionery	
18	Cocoa and cocoa preparations	
21	Miscellaneous edible preparations	
22	Beverages, spirits, and vinegar	
23	Residues and waste from the food industries; Prepared animal feed	
24	Tobacco and manufactured tobacco substitutes	
25	Salt; Sulfur; Earths and stone; Plastering materials, lime, and cement	
26	Ores, slag, and ash	
27	Mineral fuels, mineral oils and products of their distillation; Bituminous substances; Mineral waxes	
97	Works of art, collectors' pieces and antiques	**Other**
98	Special classification provisions	
99	(Imports only) Temporary legislation; Temporary modifications established pursuant to trade legislation; Additional import restrictions established pursuant to Section 22 of the Agricultural Adjustment Act, as needed	

Vita

Jennifer Moreno Escamilla was born in El Paso, TX, but lived in Ciudad Juarez, Chihuahua, from childhood until 2014. During her first years living in El Paso, TX, she completed her high school studies, class of 2017. Jennifer graduated from the University of Texas at El Paso in December 2021, earning her Bachelor of Science in Civil Engineering. After spending some years working as a peer advisor, she started working as an undergraduate research assistant at the Center for Transportation Infrastructure Systems (CTIS) under the project' Web-based Application to Visualize Performance of Regional Multimodal Corridors' funded by the El Paso Metropolitan Planning Organization. Throughout her educational career, she had the privilege of presenting posters at conferences like the 2022 NM TransCon Conference in Las Cruces and the Transportation Research Board 2023 conference.

Contact information: jenmoreno278@gmail.com