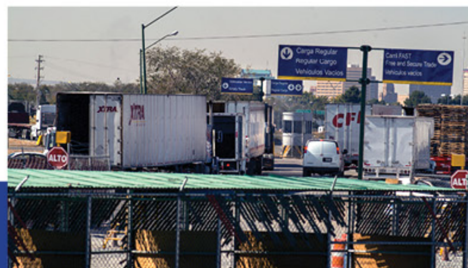
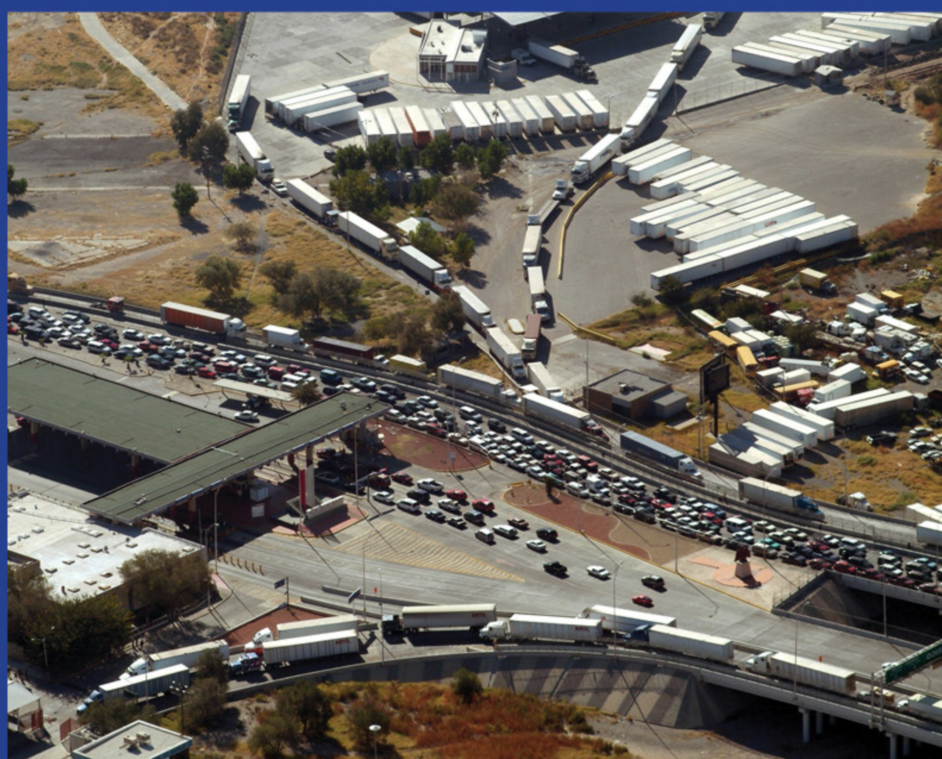
April 2023

Border Delay Costs and Texas-Mexico Trade Competitiveness:
A COMPARATIVE ANALYSIS





Study Conducted by:

Texas A&M Transportation Institute

Sponsored by:

El Paso Metropolitan Planning Organization

BORDER DELAY COSTS AND TEXAS-MEXICO TRADE COMPETITIVENESS: A COMPARATIVE ANALYSIS

by

Rafael M. Aldrete
Swapnil Samant
Okan Gurbuz
Kirbie Ferrell
Erik Vargas
Alejandro Berlanga
Mario Vazquez

Project sponsored by:
El Paso Metropolitan Planning Organization

This report was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation.

April 2023

Report prepared by
Center for International Intelligent Transportation Research
Texas A&M Transportation Institute
4050 Rio Bravo, Suite 151
El Paso, Texas 79902

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

LIST OF ABBREVIATIONS

Abbreviation	Definition
BCIS	Border Crossing Information System
BOTA	Bridge of the Americas
BTS	Bureau of Transportation Statistics
COVID-19	Corona Virus Disease of 2019
DCET	Direct Cost Estimation Tool
FAST	Free and Secure Trade
HS	Harmonized System
MPO	Metropolitan Planning Organization
TTI	Texas A&M Transportation Institute
USDOT	U.S. Department of Transportation

DISCLAIMER AND ACKNOWLEDGMENTS

This report was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. This research was performed by the Texas A&M Transportation Institute for the El Paso Metropolitan Planning Organization. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein.

The research team thanks to Eduardo Calvo, Salvador Gonzalez-Ayala, and Harrison Plourde with the El Paso Metropolitan Planning Organization and the staff at the City of El Paso International Bridges Department for their expertise and assistance in the performance of project activities.

EXECUTIVE SUMMARY

This report examines the costs associated with northbound delays at selected commercial border crossings along the Texas-Mexico border, including locations within the El Paso Metropolitan Planning Organization (MPO) planning region. The delays caused due to increased truck traffic, multiple inspections, and suboptimal configuration for vehicle access to the crossing negatively impact various stakeholders, the environment, and the economy. The study uses the Direct Cost Estimation Tool (DCET) to estimate the cost of delay to shippers and carriers[1] for northbound commercial traffic across border crossings, considering traffic volume, crossing time, and cargo commodity mix. Six border crossings were analyzed, including the Bridge of the Americas (BOTA) and the Ysleta-Zaragoza Bridge in El Paso, the World Trade Bridge and the Laredo-Colombia Solidarity Bridge in Laredo, the Veterans-Los Tomates Bridge in Brownsville, and Santa Teresa in New Mexico.

In 2022, Laredo ports had three times the northbound monthly truck volumes of El Paso region ports and eight times that of Brownsville. Although BOTA in El Paso had the highest average northbound crossing times in 2019, the World Trade Bridge had the highest median crossing time for trucks using both Free and Secure Trade (FAST) lanes and non-FAST lanes, followed by Ysleta-Zaragoza and BOTA. Santa Teresa experienced the lowest median crossing times among the border crossings in the study. Median crossing times better reflect the time experienced by trucks than average crossing times because delays at the border can be highly variable and median crossing times provide a more representative estimate of the typical crossing experience. The study also discovered that there is not much difference in average crossing times between FAST and standard vehicle lanes, which reduces the advantages of expedited inspection for FAST commercial vehicles. The study also found that the lack of access leading to the border crossing was a significant reason for delays in FAST trucks. Both types of vehicles use the same roads to access the border crossing, which results in the mixing of vehicles rather than dedicated travel lanes.

Laredo region ports carried 55 percent of just-in-time commodity crossings, El Paso region ports carried 39 percent, and Brownsville carried the remaining 6 percent. Laredo ports also reported the highest percentage of loaded trucks carrying non-just-in-time commodities. The study found that the cargo value per truck for agricultural commodities varied significantly among selected ports in 2019, with Laredo having the highest average cargo value for trucks carrying perishable goods and Brownsville having the highest value for trucks carrying non-perishable goods.

The costs of northbound delay were calculated for both shippers and carriers for 2019, with figures provided for the total cost for all trucks using each facility and for the average cost of each truck using each facility. The World Trade Bridge had the highest total shipper cost of delay at $84.5 million (followed by Zaragoza and Colombia) as well as the highest total cost of carrier delay at $61.4 million, for a total cost of delay of nearly $146 million (including both

[1] For the purposes of this report, the term "shippers" refers to maquiladoras, manufacturers, and other private businesses that use freight carriers to ship or receive goods across the border. The term "carriers" refers to cross-border drayage and long-haul freight transportation companies that transport these goods across the border for the shippers.

FAST and standard lanes). Brownsville and Santa Teresa had the lowest rates for the total direct cost of delays. Additionally, standard lanes accounted for most of the total direct cost of delay.

On a per truck basis, the El Paso ports had some of the most competitive costs of delay for shippers and carriers. For shippers, the cost of delay per truck was highest at Colombia with $138, followed by the World Trade Bridge with $119, while Zaragoza and BOTA had comparatively lower costs at $112 and $105, respectively. Brownsville and Santa Teresa had the lowest costs per truck for carriers in the group at $35 and $27, respectively.

Northbound costs of delay per truck for carriers followed a similar pattern as costs for shippers. The World Trade Bridge and BOTA had the highest average cost of delay for carriers at $61 and $44 per truck, respectively, followed by Zaragoza and Colombia, both at $33 per truck. Brownsville and Santa Teresa had the lowest costs per truck for carriers at $18 and $13, respectively.

Overall, the findings suggest that El Paso region ports, including Santa Teresa, have some of the most competitive costs of northbound delay per truck for both shippers and carriers, making it an attractive location for industry. The study provides valuable information for decision-making by stakeholders, planning agencies, and policymakers and emphasizes the importance of reducing border crossing delays for the economic competitiveness of the Texas-Mexico border region.

CHAPTER 1: INTRODUCTION

> **Border crossing delays cause significant direct and indirect costs that affect manufacturers, shippers, carriers, and society at large.**

Increased truck traffic, multiple inspections, and suboptimal vehicle access configuration at U.S.-Mexico commercial border crossings cause costly delays that negatively affect manufacturers, shippers, and consumers. Delays are commonly observed in the northbound direction but have recently started occurring in the southbound direction as well. The impact of these delays is reflected in the form of inventory costs, truck driver time, and vehicle operating costs for manufacturers, shippers, and carriers. Furthermore, these delays also have indirect costs that affect society at large, such as increased vehicle emissions and the subsequent health and climate consequences, increased cost of goods passed on to consumers, and reduced regional and national economic activity.

The El Paso Metropolitan Planning Organization (MPO) is responsible for coordinating multi-modal transportation plans in the El Paso region and studying present transportation regional patterns in relation to current and projected development. The El Paso MPO's planning area includes El Paso County, Texas, southern Dona Ana County, New Mexico, and a small portion of Otero County, New Mexico, where three commercial U.S.-Mexico border crossings are currently operating, including the Bridge of the Americas (BOTA) and the Ysleta-Zaragoza Bridge in the City of El Paso and the Santa Teresa border crossing in New Mexico. These border crossings play a significant role not only for the regional economy but also for the state and the nation.

The El Paso MPO is interested in understanding the impact of crossing delays at the border crossings on transportation patterns and potential development within its planning region and comparing these delays with those at other border crossings along the U.S.-Mexico border. This study documents the costs of northbound delays at border crossings within the El Paso MPO planning region and compares them with those at selected border crossings along the Texas-Mexico border. The study aims to help the El Paso MPO communicate to regional, state, and national stakeholder audiences how its regional border crossings compare to those in other regions and emphasize the importance of reducing border crossing delays for the economic competitiveness of the Texas-Mexico border region.

1.1 BACKGROUND

The cost of commercial border crossing delays at border crossings is often estimated based on generalized assumptions about traffic volume and commodity value. Researchers at the Texas A&M Transportation Institute (TTI) Center for International Intelligent Transportation Research have developed a tool called the Direct Cost Estimation Tool (DCET) to provide more accurate estimates. The DCET considers traffic volume, crossing time, and cargo commodity mix at an hourly resolution. This tool is useful to stakeholders, planning agencies, and policymakers in comparing the cost of delay for commercial traffic across border crossings.[2]

Different border crossings have varying traffic volumes and commodity mixes. For example, the El Paso region carries a significant amount of manufactured goods, while Laredo has a broader mix of commodities and higher volumes. On the other hand, the Veterans Bridge border crossing in Brownsville carries less traffic but handles a significant amount of perishable goods that require refrigerated transport. The DCET acknowledges that the cost of delay differs for high-value cargo, such as just-in-time electronics, versus low-value cargo, such as construction materials. Time-of-day congestion also affects the cost of delay. The DCET can provide valuable information to stakeholders, planning agencies, and policymakers for decision-making.

1.2 STUDY OBJECTIVES

This study aims to achieve two objectives. First, to estimate the commodity-based direct economic costs of northbound delays at various commercial border crossings in Texas and the Santa Teresa border crossing in New Mexico using the DCET. Second, to present a data-driven framework that assists the El Paso MPO in evaluating and prioritizing improvements to reduce delay costs. The border crossings selected for this study are listed below and shown in Figure 1:

This study compares commodity-based direct costs of northbound border delays at commercial border crossings and provides a data-driven framework for the El Paso MPO to evaluate improvements to reduce them.

1. BOTA in El Paso.
2. The Ysleta-Zaragoza Bridge in El Paso.
3. The World Trade Bridge in Laredo.
4. The Laredo-Colombia Solidarity Bridge in Laredo.
5. The Veterans-Los Tomates Bridge in Brownsville.
6. Santa Teresa border crossing in Santa Teresa, New Mexico (El Paso metropolitan area).

By considering the value and volume of transported commodities, the study enables a comparison of the impacts of border crossing northbound delays across the six selected border crossings as well as an identification of the effect of cargo mix on the costs of delay. The findings of this study provide the El Paso MPO with a comprehensive data-driven framework to evaluate and prioritize improvement projects that aim to reduce costs of delay.

[2] Aldrete, R.M., Salgado, D., Samant, S. and Vazquez, M., 2018. Estimating Economic Impact of Commercial Vehicle Border Delays in Real Time. https://static.tti.tamu.edu/tti.tamu.edu/documents/185917-00019.pdf

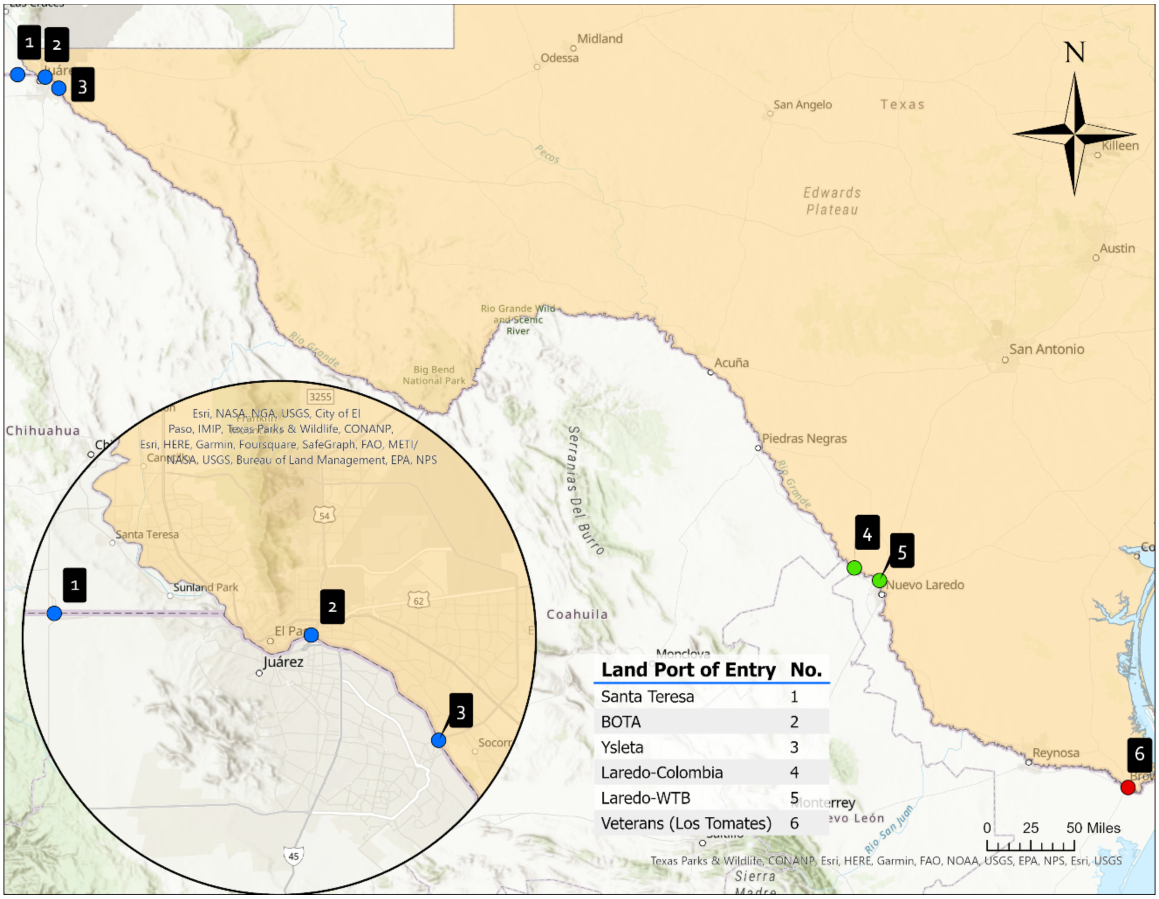


Figure 1. Selected Commercial Border Crossings for the Study.

1.3 ORGANIZATION OF REPORT

This report is divided into four chapters, starting with this introduction, which provides the background and objectives of the study. Chapter 2 summarizes the approach and methodology used by TTI researchers to conduct the study. In Chapter 3, the inputs used in the analysis are described, including the data and sources used, the calculation processes of the DCET, and a comparison of the impacts of border crossing delays across the six selected border crossings. The final chapter, Chapter 4, presents the insights gained from the comparative analysis, limitations of the study, and the implications of these findings for the El Paso MPO and other border stakeholders.

CHAPTER 2: APPROACH AND METHODOLOGY

This chapter discusses the approach and methodology used in the study. The approach followed three principles: location selection based on objective and comparable data availability, segregation of traffic volume and commodity data by border crossing facility location, and application of current activity and/or location-specific costs. The methodology consisted of four consecutive tasks, including collecting and processing data, running the DCET, performing a comparative analysis, and preparing a final report.

2.1 APPROACH

The main goal of this study, as mentioned in Chapter 1, was to determine the direct economic costs of northbound delays, identify the factors that impact them, and compare them across commercial U.S.-Mexico border crossings in Texas and New Mexico. To ensure that the analyses were consistent and comparable across all locations, researchers developed an approach that followed three principles:

The analysis followed three key principles: objective and comparable location selection, segregation of data by LPOE facility location, and location-specific costs.

- **Location selection.** For the sake of objectivity and comparability, the researchers selected border crossings in Texas and New Mexico based on the availability of northbound commercial vehicle border crossing delay information from the Border Crossing Information System (BCIS) during the chosen timeframe.[3] The six border crossings presented in the previous chapter were selected for having consistent data availability for northbound traffic in 2019, the most recent and representative timeframe before the COVID-19 pandemic.

- **Segregate traffic volume and commodity data by border crossing location while ensuring consistency with official data.** To ensure consistency with official data, the researchers segregated traffic volume and commodity data by border crossing location. The U.S. Department of Transportation (USDOT) Bureau of Transportation Statistics (BTS) publishes monthly northbound traffic volumes and commodity data. However, BTS data are sometimes aggregated at the administrative U.S. Customs and Border Protection Port level, so researchers used a second source of Mexican Customs Import/Export data called Datamyne for the year 2019.[4] This allowed researchers to identify northbound commodity volumes for each of the five border crossing facilities selected. The researchers cross-checked the data from both sources to ensure consistency. The study period was limited to one year of 2019 to take advantage of the Datamyne dataset and reliable crossing time data obtained from BCIS. Additionally, this provides the latest entire year of data before the COVID-19 pandemic's impacts were seen on cross-border traffic.

[3] https://bcis.tti.tamu.edu/Commer/Home
[4] The Mexican Customs Import/Export dataset for 2019 was acquired by TTI as part of a different study in 2020.

- **Apply current activity and/or location-specific costs.** To accurately estimate the direct economic costs of northbound border delays using the DCET, several cost inputs from both shippers and carriers were required. However, some of these costs, such as fuel costs, may vary depending on the location. To address this, the researchers updated the DCET cost attributes to reflect the economic conditions of 2019, including location-specific fuel costs. The following sections will provide more detailed information on these updates.

2.2 METHODOLOGY

The methodology for this study consisted of four consecutive tasks as follows:

1. **Collect and Process Data.** Researchers gathered and processed the required datasets for each border crossing. This included northbound crossing times from the BCIS, northbound traffic volume and values from the U.S. BTS, and Mexican Customs Import/Export datasets from Datamyne. Since data for different border crossings varied based on spatial and temporal coverage, the researchers imputed and/or interpolated data to achieve uniformity where necessary.

2. **Run the DCET.** In this task, researchers loaded all datasets from Task 1 into the DCET. The tool generated direct economic costs of delay for each border crossing, broken down into shipper, carrier, and total costs, expressed in USD per month.[5] The results were analyzed to identify patterns and trends and to see how northbound traffic volumes and commodity values affected costs at each border crossing.

3. **Perform Comparative Analysis.** This task involved analyzing the results from Task 2 and conducting a comparative analysis of the selected border crossings. The comparison not only looked at the direct economic costs of northbound delay at each border crossing but also highlighted the impact of the cargo mix on these costs.

4. **Prepare Final Report.** A final report was created to document the methodology and outcomes of the tasks listed above.

[5] For the purposes of this report, the term "shippers" refers to maquiladoras, manufacturers, and other private businesses that use freight carriers to ship or receive goods across the border. The term "carriers" refers to cross-border drayage and long-haul freight transportation companies that transport these goods across the border for the shippers.

CHAPTER 3:
NORTHBOUND COMMERCIAL BORDER DELAYS COST ANALYSIS

This chapter presents the cost analysis of northbound commercial border delays at the Texas-Mexico border crossings selected for the study by utilizing the DCET framework, which comprises three key elements: inputs, processes, and outputs, as shown in Figure 2. The aim is to draw insights into what border delays cost at each border crossing based on the main commodities transported across at each location.

To achieve this goal, the chapter begins by describing the inputs used in the analysis, including the data and sources used for the border crossings examined in the study. This provides a comparison across border crossings for each of the inputs, allowing for insights into the similarities and differences in the commodities shipped across location, and the magnitude of northbound border crossing delay at each location. Next, the chapter summarizes the DCET processes used to estimate each of the tool's outputs.

Finally, the chapter describes the DCET outputs estimated for each border crossing, including a comparative analysis of the insights that a commodity-based cost of delay analysis can provide. By exploring these outputs, the chapter draws insights into what border delays cost at each border crossing and how the composition of commodities being transported influences these costs.

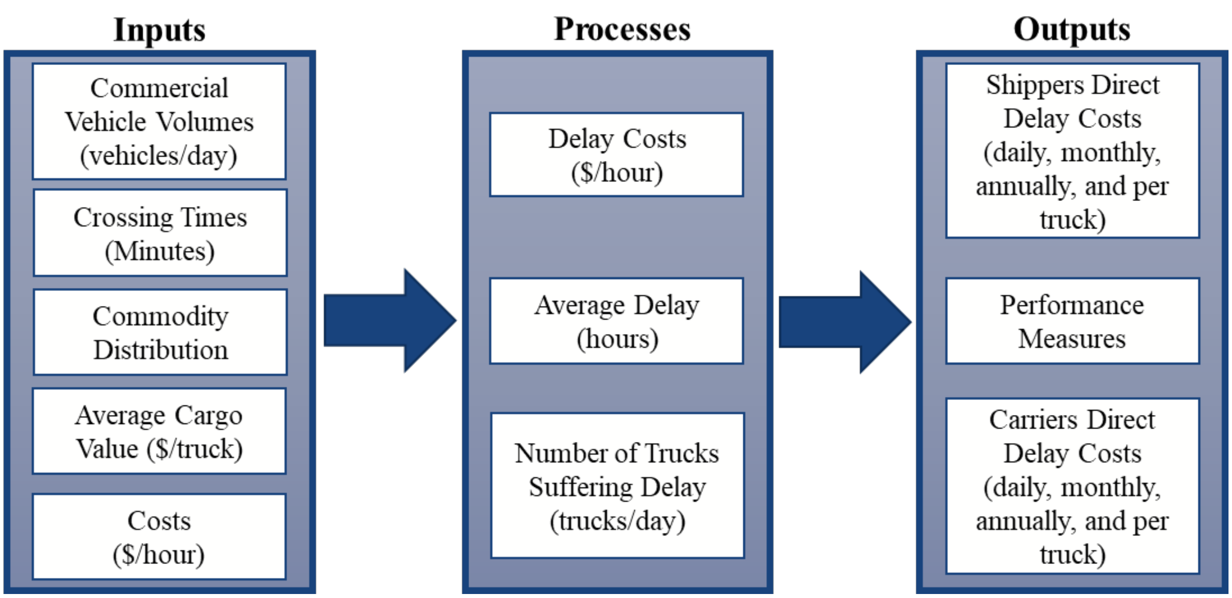


Figure 2. Direct Cost Estimation Tool.

3.1 ANALYSIS INPUTS

The DCET utilizes a range of inputs to calculate daily, monthly, annual, and per-truck northbound costs from the perspectives of shippers and carriers. These inputs include commercial vehicle volumes (measured in vehicles per month or per day), crossing times (measured in minutes), commodity distribution, average cargo value (measured in dollars per truck), and costs (measured in dollars per hour). Users of the tool can adjust these parameters to better align with their specific goals. The inputs utilized for this study at each location are described in the paragraphs that follow.

3.1.1 Commercial Vehicle Volumes

The monthly northbound commercial vehicle volumes used in this study were mainly obtained from USDOT BTS. BTS provides monthly values for both loaded and empty trucks, which were used to estimate the number of empty and loaded commercial vehicles crossing per day per commodity. The tool utilized the number of loaded trucks as an input parameter. However, BTS groups certain ports of entry into one large region, meaning that the BOTA and the Ysleta-Zaragoza Bridge in El Paso, as well as the World Trade Bridge and the Laredo-Colombia Solidarity Bridge in Laredo, had their commercial vehicle volumes in terms of loaded truck rates reported as a combined whole (i.e., BOTA and Ysleta border crossings combined, and the World Trade Bridge and Colombia border crossings combined).

- **In 2022, with about 240,000 northbound trucks per month, Laredo ports had three times the monthly truck volume of El Paso and eight times that of Brownsville.**
- **Between 2018 and 2022, Brownsville and Laredo ports experienced northbound volume increases two and three times greater than those in the El Paso region.**

Figure 3 presents a graphical representation of the number of commercial vehicles that entered the United States through selected border crossings. The Santa Teresa border crossing located in New Mexico (within the El Paso MPO) was combined with the El Paso ports (i.e., BOTA and Ysleta-Zaragoza) due to its proximity to El Paso. Similarly, the World Trade Bridge and Colombia ports were aggregated under the Laredo ports. The vertical bars in Figure 3 represent the monthly commercial vehicle volumes from January 2018 to September 2022, while the horizontal bars show the yearly average for each region. Comparing the years 2018 and 2022 revealed that Laredo ports (green bars) had an average increase in volume of around 20 percent. Meanwhile, El Paso ports (blue bars), including Santa Teresa, only experienced a volume increase of less than 10 percent. For the purposes of comparing the regions, the Brownsville port is not demonstrated in Figure 3.

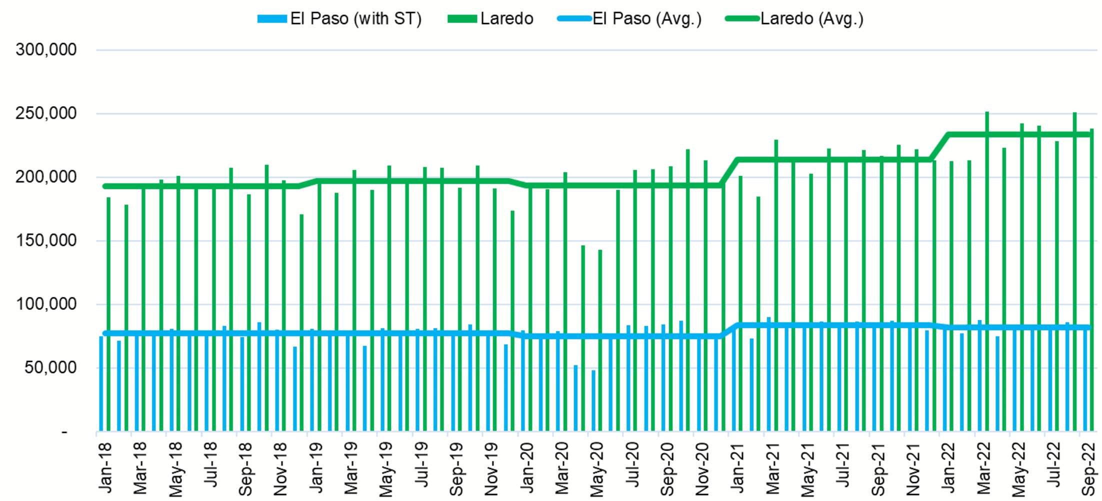


Figure 3. Monthly Commercial Vehicle Volumes (Selected Ports).[6]

Figure 4 provides a closer look at the loaded truck rates within the selected year of analysis, 2019. As noted earlier, this year was chosen for two reasons: first, it had the best available annual data, and second, it was not impacted by the COVID-19 pandemic. Figure 4 displays the monthly rate of northbound loaded trucks crossing the border. For instance, between 75 and 80 percent of all commercial vehicles crossing northbound through El Paso ports, including Santa Teresa port, were reported as loaded trucks. Meanwhile, loaded truck rates were slightly lower for Laredo ports but significantly lower for Brownsville.

In 2019 El Paso ports had the highest percentage of loaded northbound trucks at around 78 percent, followed by Laredo at around 72 percent, and Brownsville at the lowest with about 52 percent.

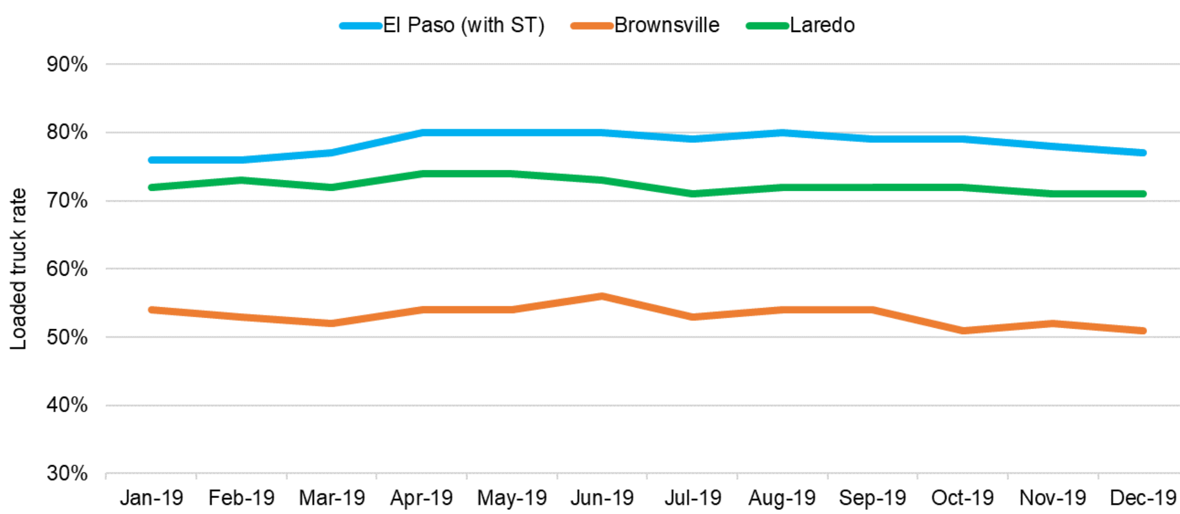


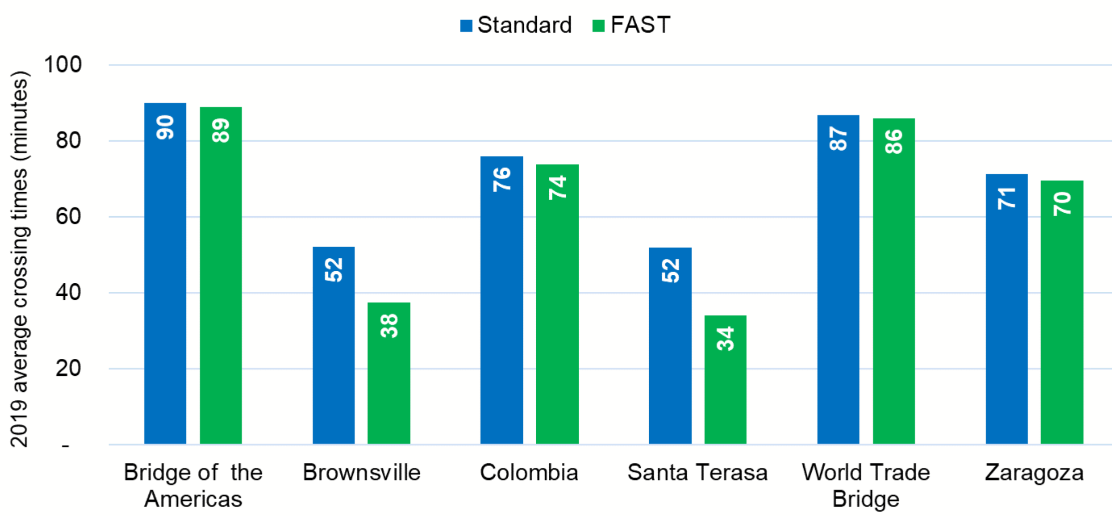
Figure 4. Commercial Vehicle Volumes and Loaded Truck Rates—2019.[6]

[6] Bureau of Transportation Statistics. Border Crossing/Entry Data. https://www.bts.gov/browse-statistical-products-and-data/border-crossing-data/border-crossingentry-data

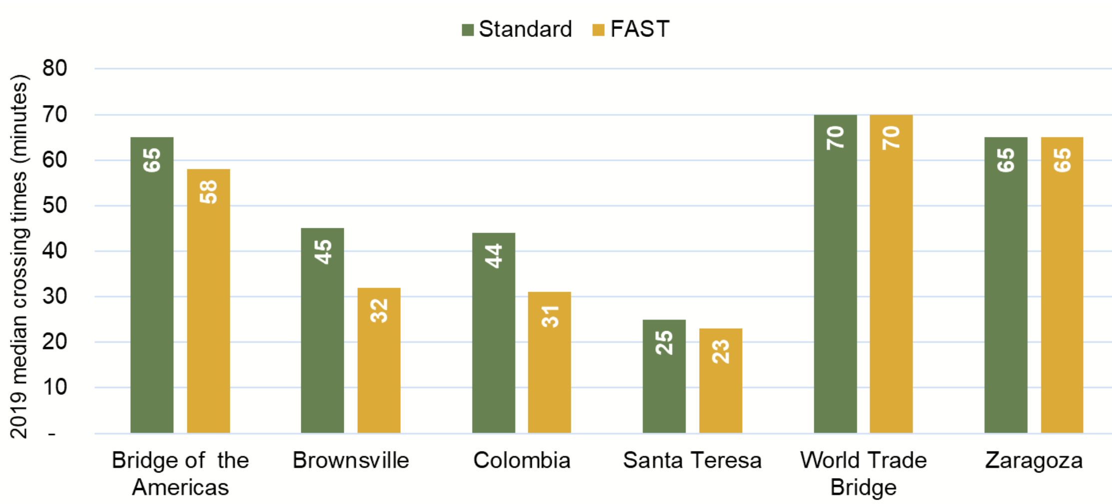
3.1.2 Crossing Times

The World Trade Bridge had the highest median northbound crossing time for both FAST and non-FAST trucks, followed by two El Paso ports, Ysleta-Zaragoza and Bridge of the Americas.

In 2019, the BCIS crossing time data were analyzed for the selected border crossings, with the highest average crossing time found at BOTA in El Paso. Median crossing times were also analyzed to avoid including outliers. It was found that the order of crossing times per port changed when looking at median values instead of averages. For this analysis, considering the median crossing times is better than the average because the median reflects the crossing time that most trucks crossing experience, providing a better representation of typical crossing times. When considering the median crossing times, the World Trade Bridge had the highest median crossing time for both FAST and non-FAST trucks, followed by two El Paso ports, Zaragoza-Ysleta and BOTA. These results are presented in Figure 5.



(a) Average crossing times



(b) Median crossing times

Figure 5. Average and Median Crossing Times at Selected Ports.

3.1.3 Analysis of Commodity Distribution

In this study, data sources were used to gather information about commodities using the Harmonized System (HS) Codes. These codes provide a standardized way of classifying traded products. BTS offers monthly information on weight and value of inbound trade goods, aggregated by the first two digits of their HS codes. In contrast, Datamyne has information on all imported goods with their respective HS codes. To simplify the analysis, this study followed the BTS approach and grouped the HS codes according to the first two digits. The HS codes were then grouped into three main categories, with five subgroups in total. Figure 6 shows the grouping of agricultural goods into perishable and non-perishable subgroups, while manufactured goods were categorized into just-in-time and non-just-in-time commodities. A few remaining commodities were grouped under the "other" category. By categorizing commodities in this way, the tool is better able to estimate costs associated with transporting each group.

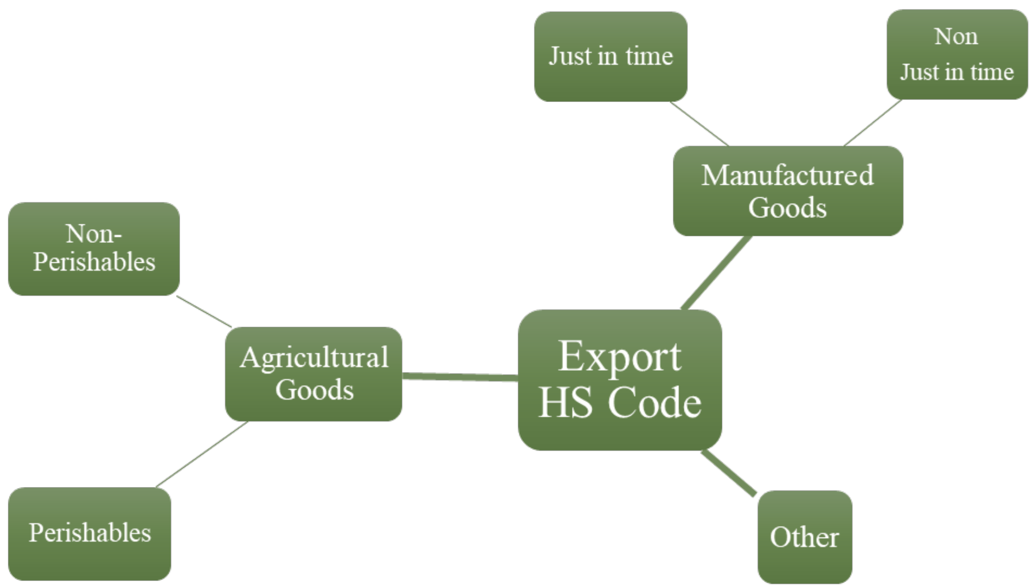


Figure 6. Commodity Distribution Groups.

The appendix of this report presents a comprehensive list of all commodity codes utilized by BTS, along with their detailed descriptions. Additionally, the appendix provides information regarding the selected commodity distribution groups used as input for the DCET.

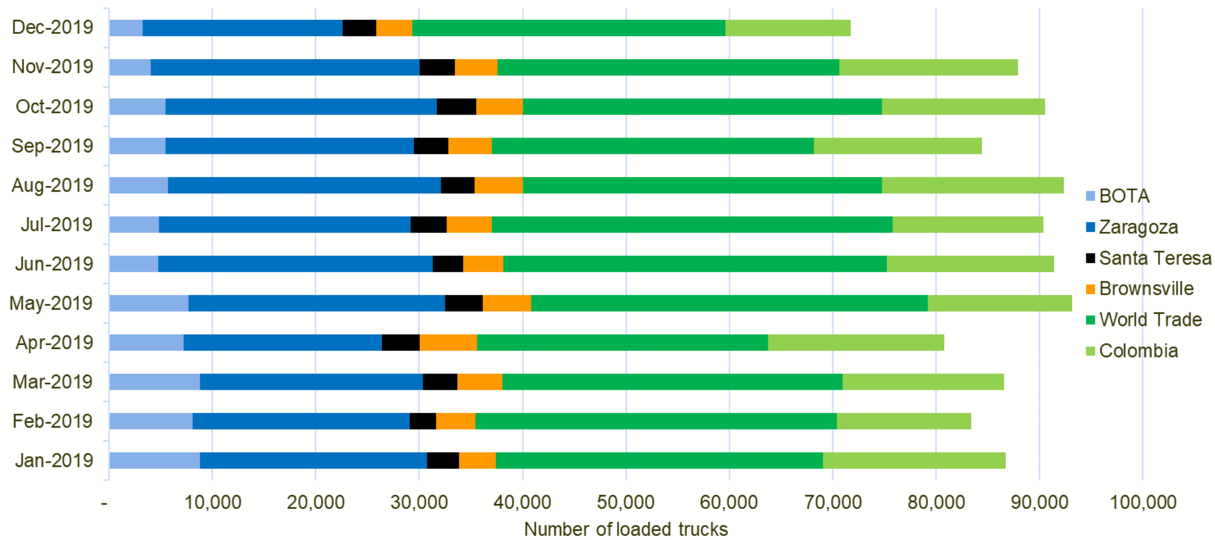
This study collected information on the distribution of northbound commodities and the value of cargo from two different data sources. The first source is BTS, which provides publicly available data on the number of truck crossings at the "Port" level. A Port can refer to either a group of border crossings located in the same border municipality or a single border crossing. For example, the Laredo Port includes the World Trade Bridge and Laredo-Colombia Solidarity Bridge, while the Brownsville Port only includes the Veterans-Los Tomates Bridge. The BTS datasets are reported annually or monthly. The El Paso region had a special case: BOTA and Ysleta-Zaragoza Bridge used to be reported together under El Paso Port until March 2020. After that they stared to be reported separately.

The second data source is Datamyne, a third-party data provider of global trade data. This company offers access to a database of detailed import and export information, including the weight and value of cargo.[7] For this study, data was collected from all U.S.-Mexico import and export shipments that occurred in 2019 through each selected border crossing. Datamyne's data was used to allocate the Port level BTS data to the selected border crossings. For instance, the El Paso Port information was split into BOTA and Ysleta-Zaragoza border crossings, while Laredo Port information was divided into the World Trade Bridge and Colombia border crossings.

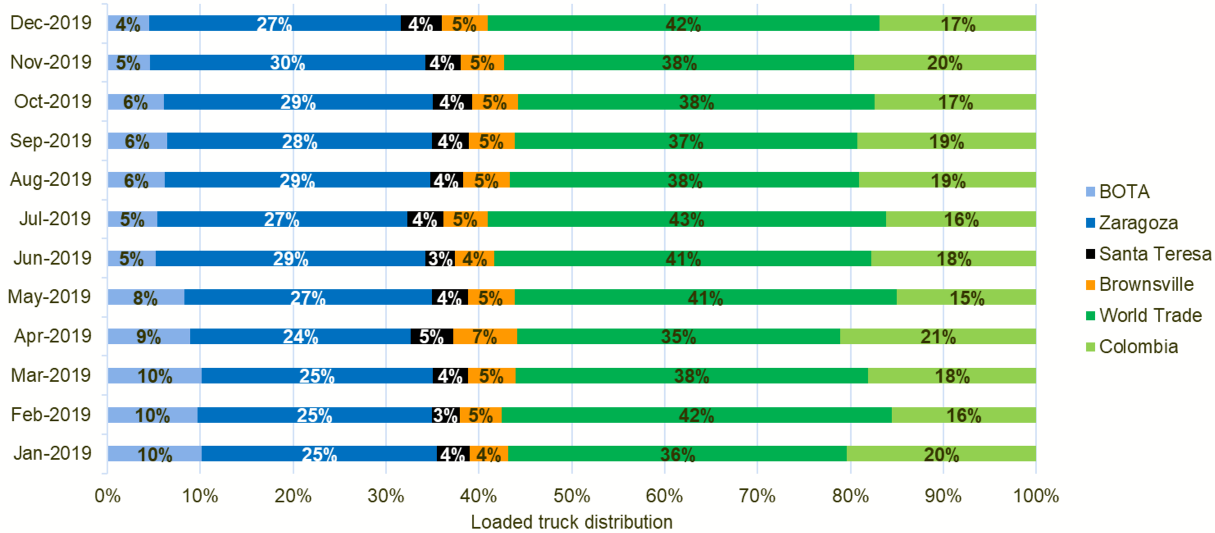
In 2019, Laredo region ports carried 55 percent of the just-in-time commodity crossings in the selected crossings, El Paso region ports carried 39 percent, and Brownsville carried the remaining 6 percent.

The two data sources used in this study, BTS and Datamyne, both provide monthly information on transported goods, including the weight and value of the goods. BTS provides number of loaded trucks by land port of entry level. To estimate the number of loaded trucks for each crossing for different commodity groups, the weight of the commodities reported by Datamyne for each crossing was used along with BTS number of truck information. Figure 7 to Figure 11 illustrate the estimated number of loaded trucks crossing each selected port in 2019 as well as the monthly change in distribution of each commodity group. In 2019, the monthly number of loaded trucks carrying just-in-time commodities ranged between 70,000 and 100,000, with the lowest crossings occurring in December and the highest in May (Figure 7a). Among the selected ports, the El Paso ports including Santa Teresa were responsible for between 35 and 39 percent of just-in-time commodity crossings (Figure 7b).

[7] Descartes Datamyne, https://www.datamyne.com/



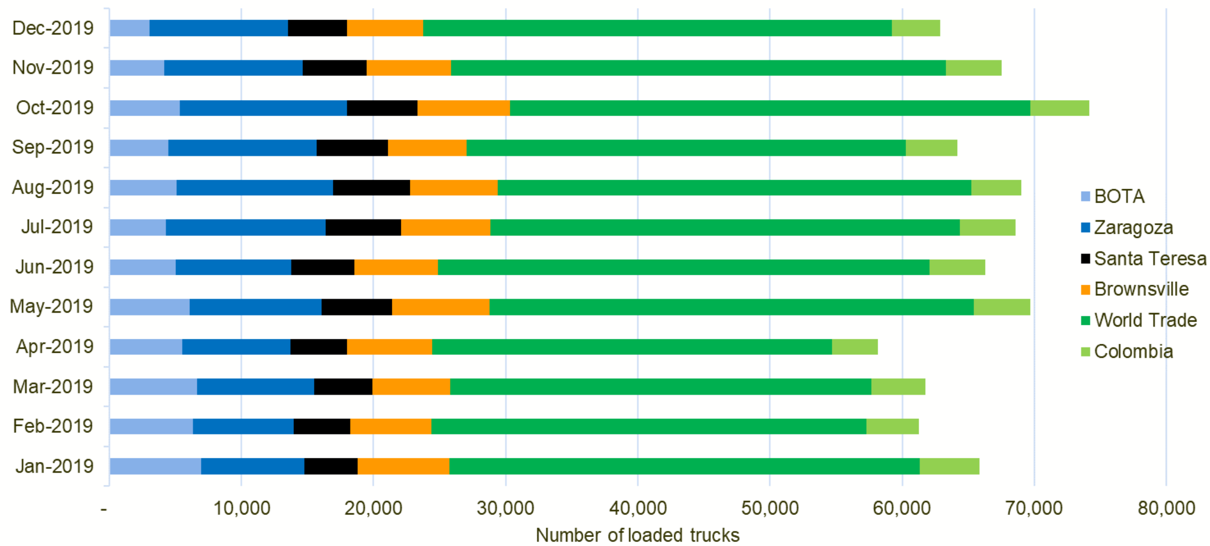
(a) Number of loaded trucks



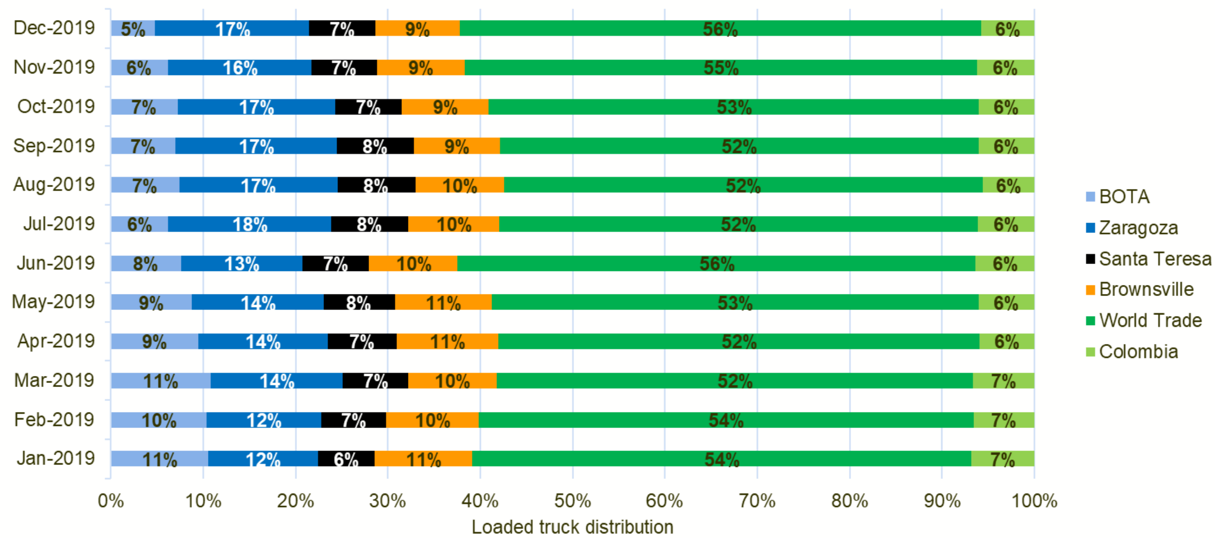
(b) Loaded truck distribution

Figure 7. Commodity Distribution—Just-in-Time.

According to the data, the highest number of non-just-in-time commodity crossings occurred in October 2019 with approximately 74,000 loaded trucks, while the lowest volume was recorded in April with just over 58,000 loaded trucks (Figure 8a). Among the selected ports, Laredo ports reported the highest percentage of loaded trucks carrying non-just-in-time commodities, accounting for between 58 percent and 62 percent of all loaded trucks (Figure 8b).



(a) Number of loaded trucks

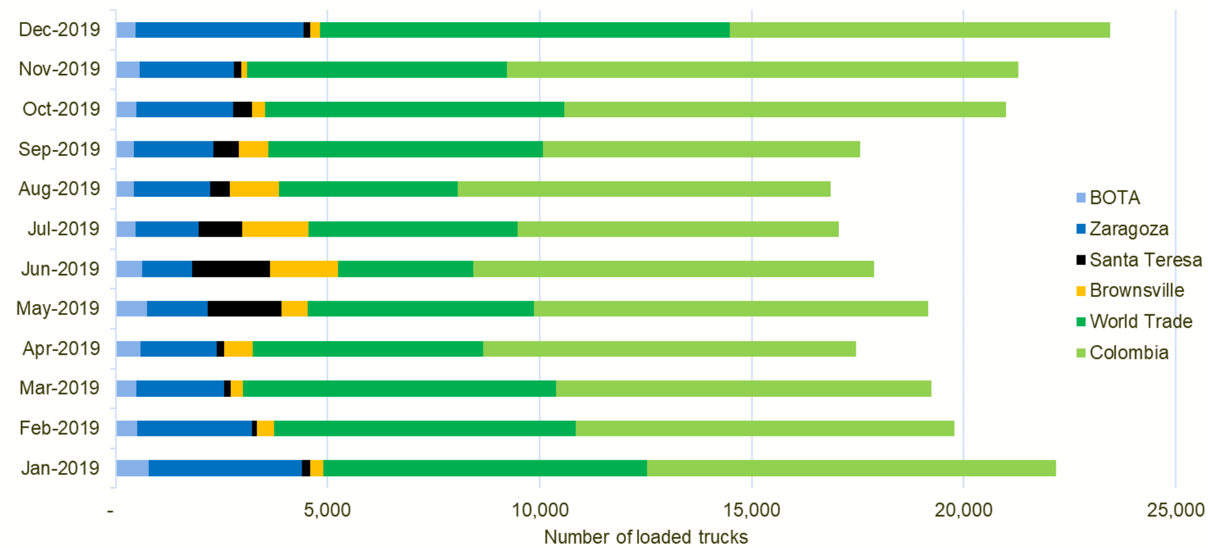


(b) Loaded truck distribution

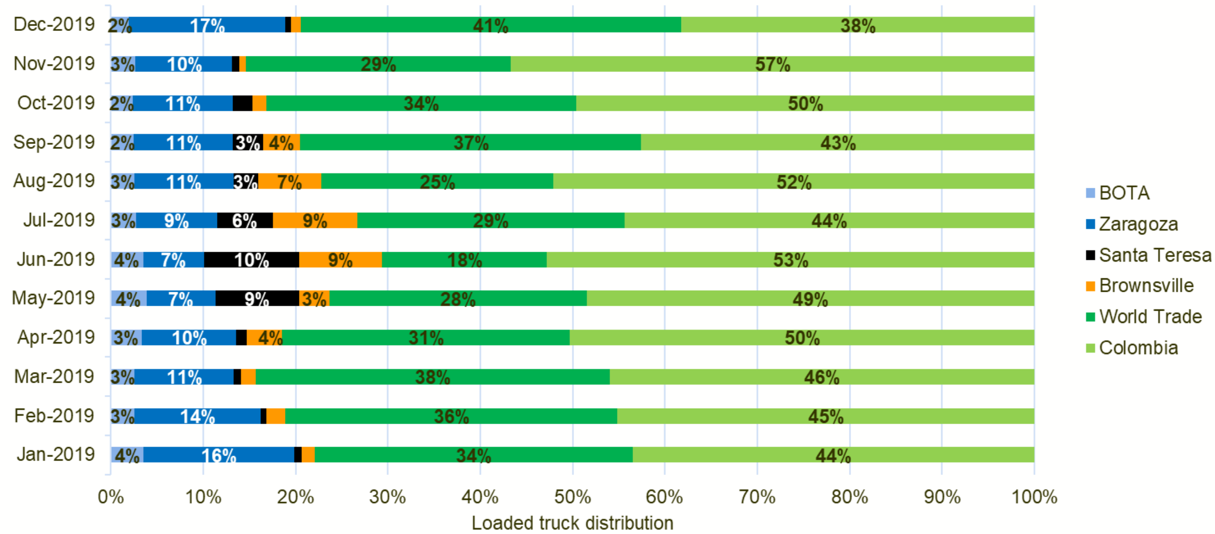
Figure 8. Commodity Distribution—Non-Just-in-Time.

The largest volume of imported perishable goods was recorded in December 2019, followed by January 2019, with both months having close to 25,000 loaded trucks crossing the selected ports. Figure 9 shows that most of the trucks carrying perishables through the selected ports crossed through the Laredo ports, primarily through the Colombia border crossing.

Most trucks carrying perishable and non-perishable goods among the selected ports went through the Laredo ports, with the Colombia land port of entry handling most of the perishables and the World Trade Bridge handling most of the non-perishables.



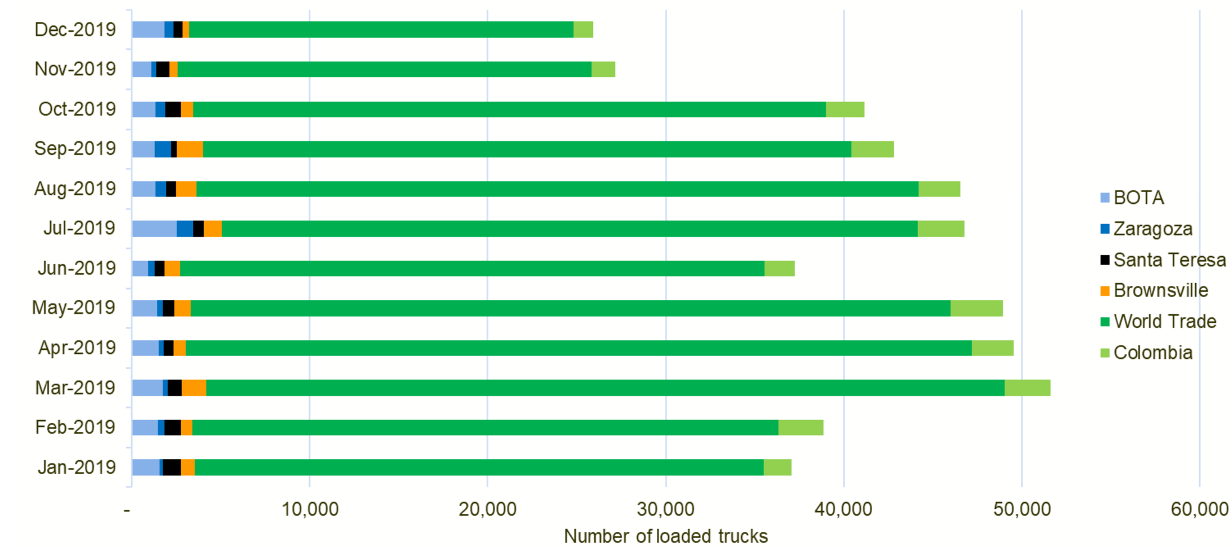
(a) Number of loaded trucks



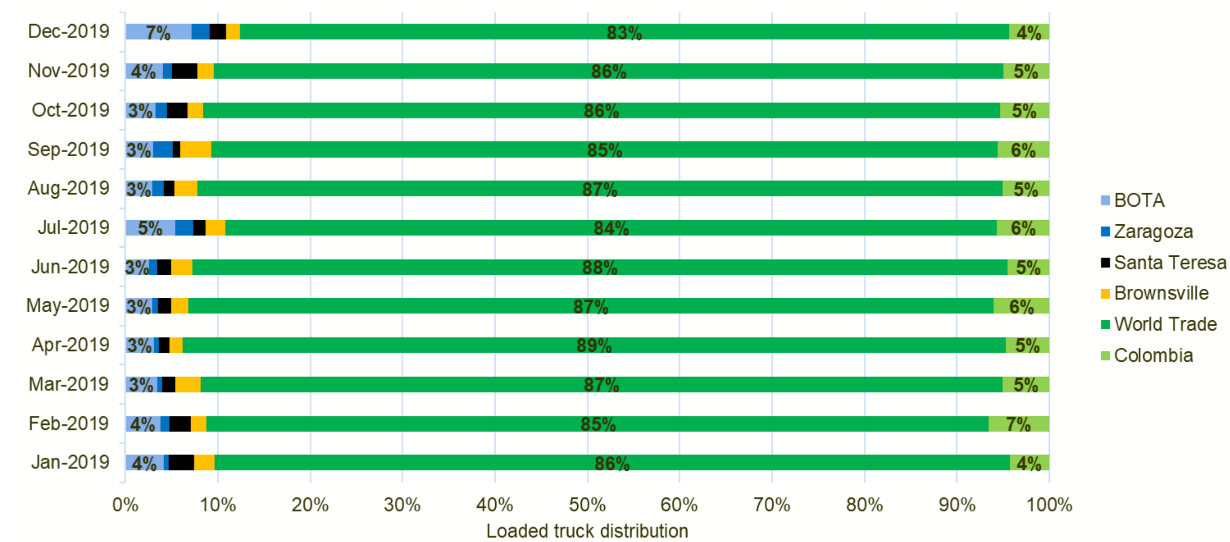
(b) Loaded truck distribution

Figure 9. Commodity Distribution—Perishables.

Non-perishable agricultural goods were mainly transported through Laredo ports, with over 90 percent of all trucks carrying such goods using these ports. Figure 10 shows that most of the trucks preferred to use the World Trade Bridge in Laredo for transporting non-perishable agricultural goods.



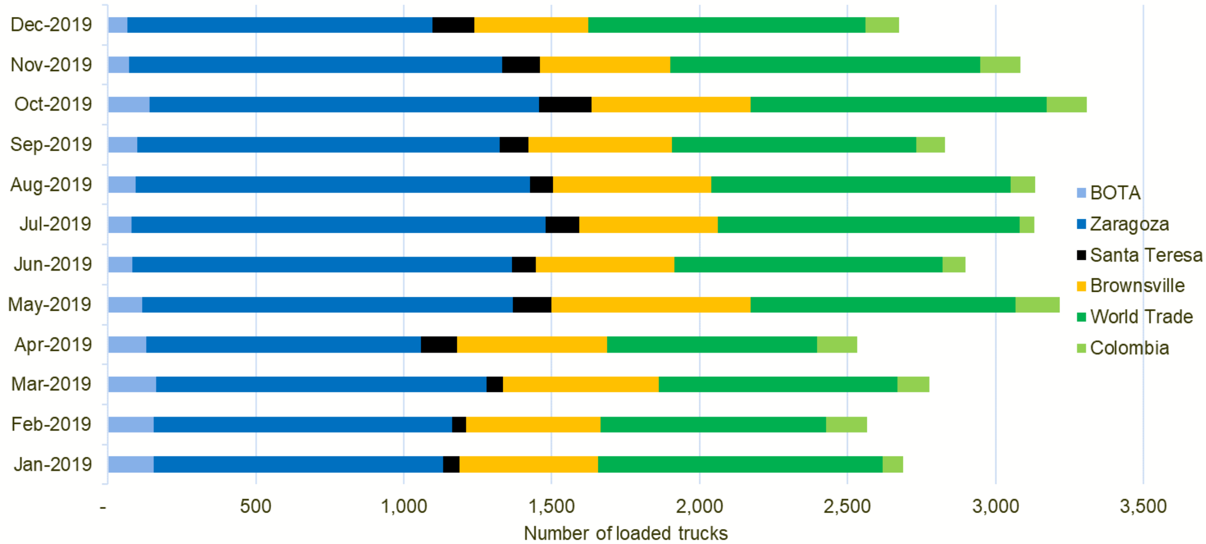
(a) Number of loaded trucks



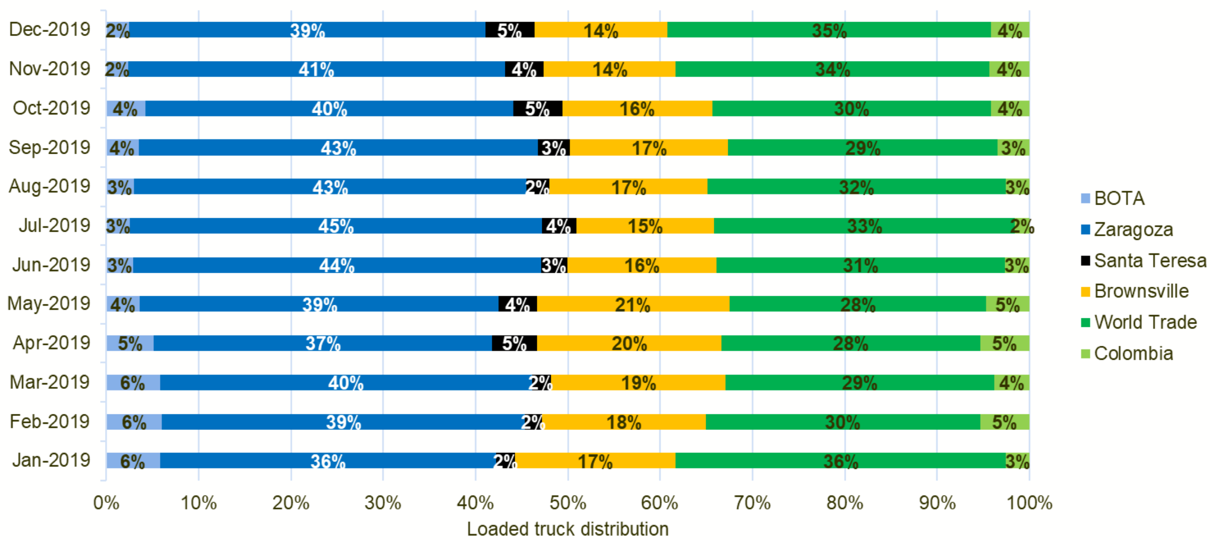
(b) Loaded truck distribution

Figure 10. Commodity Distribution—Non-Perishables.

The distribution of the remaining commodity groups was relatively even among the selected ports, with no single port dominating the crossings. The highest number of trucks carrying these commodities crossed through the Zaragoza border crossing, followed closely by the World Trade Bridge and the Brownsville border crossing, as shown in Figure 11.



(a) Number of loaded trucks



(b) Loaded truck distribution

Figure 11. Commodity Distribution—Other.

3.1.4 Estimation of Average Cargo Values

The average cargo value per loaded commercial vehicle was calculated using monthly cargo values and volumes from BTS data for the selected border crossings. Total cargo values were divided by number of loaded trucks to find the estimated average cargo values. Figure 12 displays the fluctuations in the average cargo value for just-in-time commodities at the selected ports in 2019. The selected regions (El Paso including Santa Teresa, Brownsville, and Laredo) had similar monthly average cargo values ranging from $100,000 to $140,000. Santa Teresa helped to increase the overall average cargo value for the El Paso region.

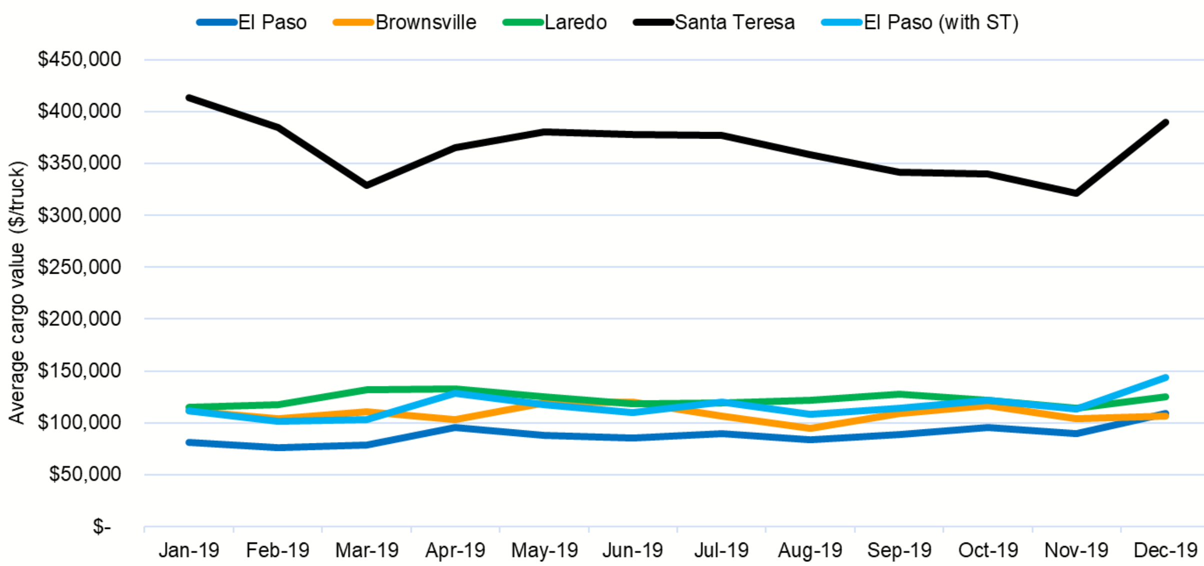


Figure 12. Average Cargo Value—Just-in-Time.

The average cargo value for just-in-time manufactured goods was similar across all border crossings, but for non-just-in-time manufactured goods, it was significantly higher in the Laredo ports.

The average cargo value for non-just-in-time manufactured goods was significantly higher in Laredo compared to other regions, as shown in Figure 13. While other regions had an average cargo value per truck of under $30,000, Laredo's average cargo value was around $50,000 per truck.

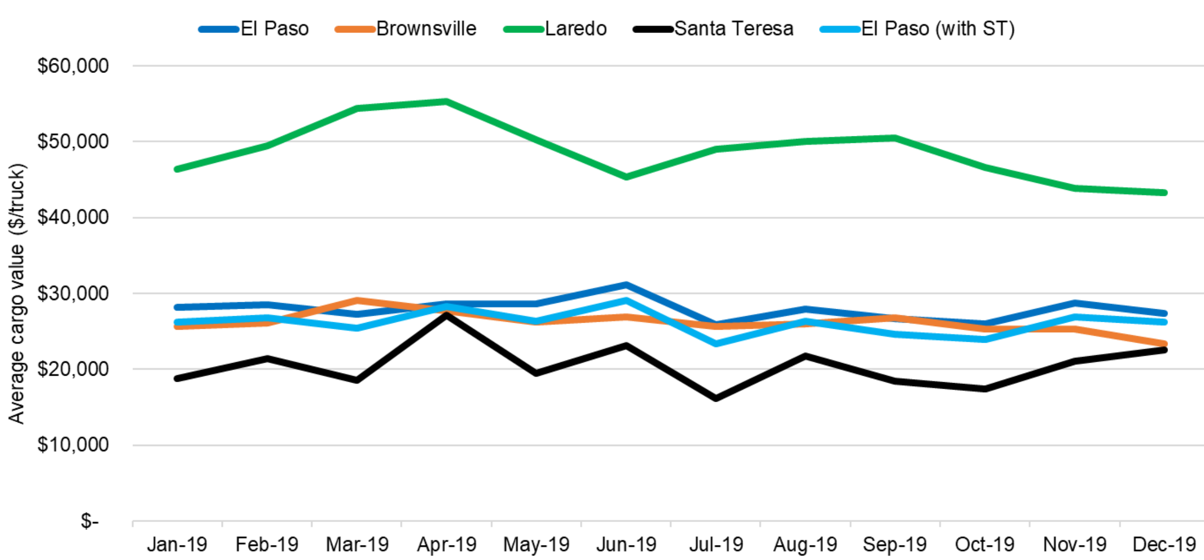


Figure 13. Average Cargo Value—Non-Just-in-Time.

The average cargo value per truck for trucks carrying perishable commodities varied widely among the selected ports in 2019. For example, Laredo experienced the highest average cargo value in April 2019, with over $35,000 per truck, while Brownsville had its lowest value in June 2019, with less than $5,000 per truck (Figure 14).

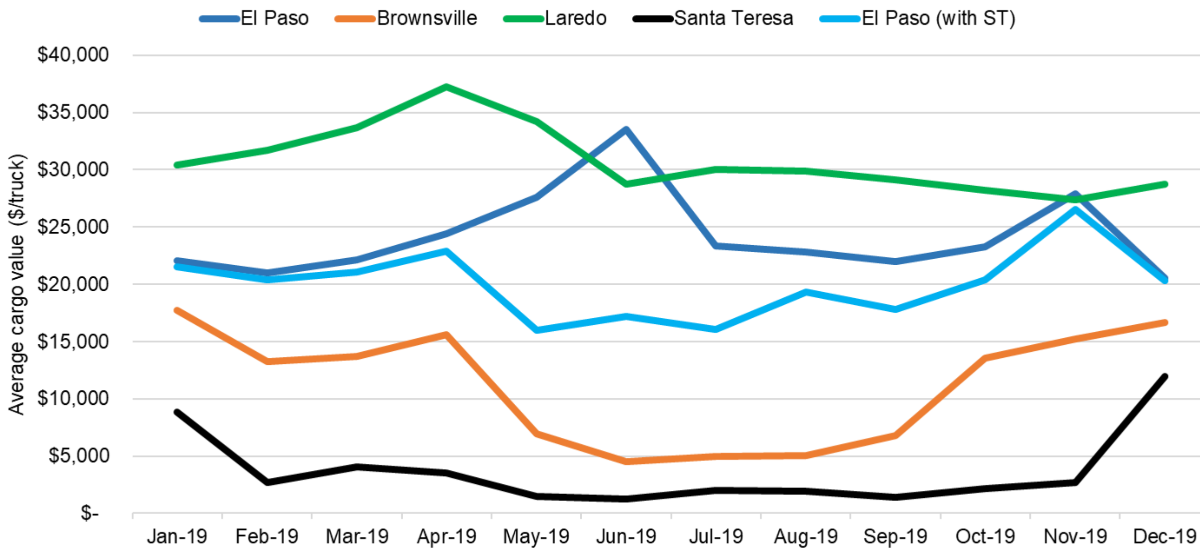


Figure 14. Average Cargo Value—Perishables.

The cargo value per truck for agricultural commodities varied significantly among selected ports in 2019, with Laredo having the highest average cargo value for trucks carrying perishable goods and Brownsville having the highest average cargo value for trucks carrying non-perishable goods.

In contrast to the average cargo values for perishables, which were the lowest among selected ports for Brownsville, the Brownsville port experienced the highest average cargo value for non-perishable goods, with two peaks in April and October 2019, reaching around $25,000 per truck (Figure 15). Meanwhile, the average cargo values for non-perishable goods in other ports remained under $15,000 per truck. This suggests that Brownsville may have a higher volume of high-value non-perishable goods transported through its port compared to other selected ports.

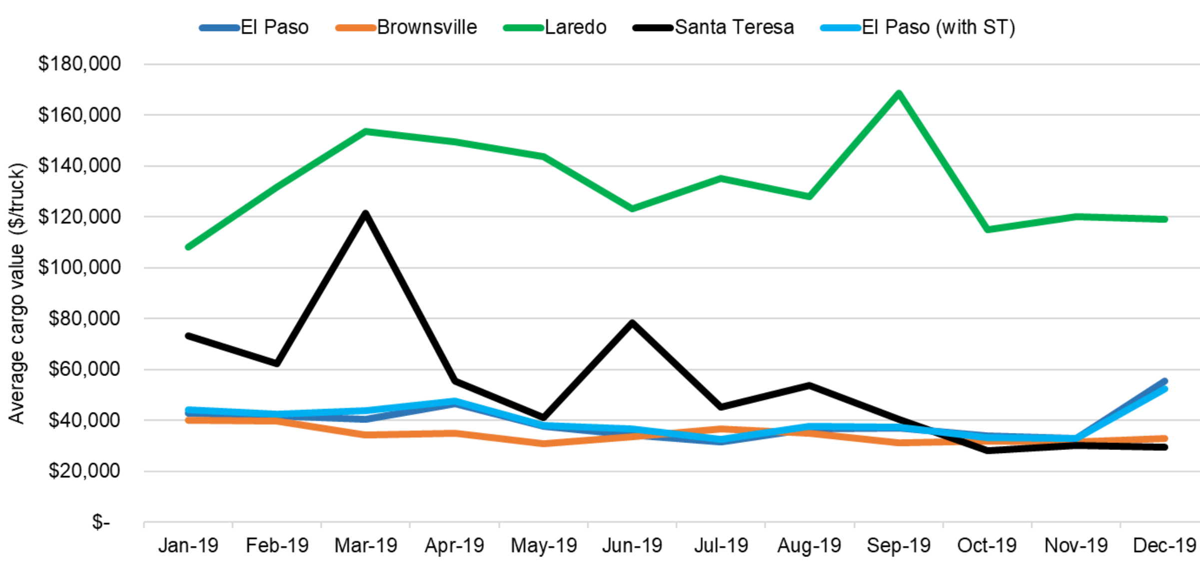


Figure 15. Average Cargo Value—Non-Perishables.

In the other goods category, the average cargo value per truck for El Paso and Brownsville ports were found to be similar. However, Laredo ports showed significantly higher average cargo values, as demonstrated in Figure 16.

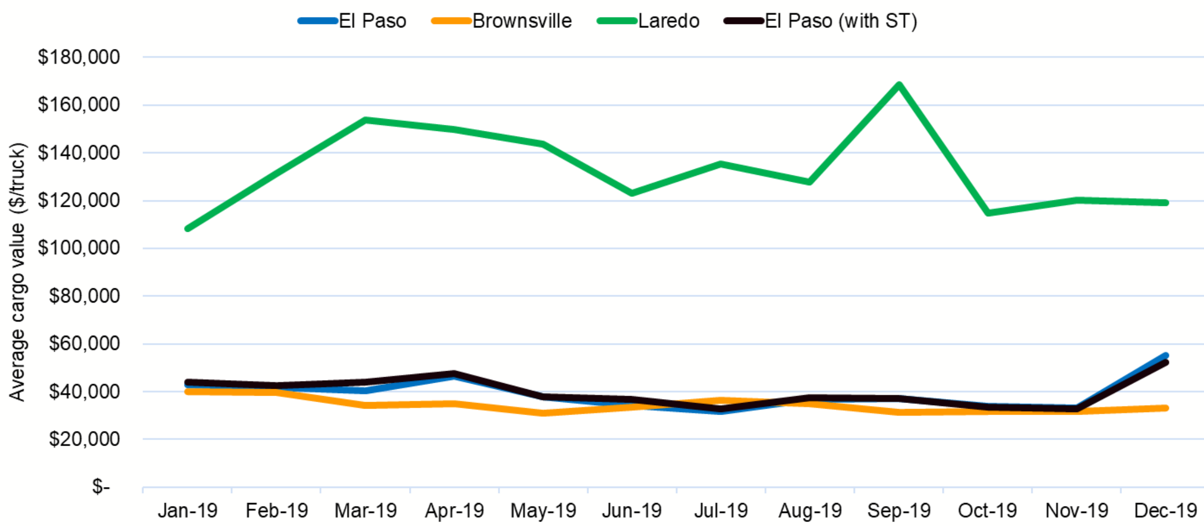


Figure 16. Average Cargo Value—Other.

3.1.5 Calculation of Costs

The costs were calculated separately for the shippers and carriers, as shown in Figure 17. The shipper costs were computed based on two inputs: (a) inventory cost and (b) additional logistic cost. The inventory cost consisted of the inventory capital cost and risk costs. As previous studies used, based on the Council of Supply Chain Management, the inventory capital cost was determined as 3.25 percent of the average cargo value. The inventory risk cost was calculated as 18 percent of the average cargo value for just-in-time commodities and 9 percent of the average cargo value for perishables.[2,8]

[8] Vadali, Sharada R., Dong Hun Kang, and Karen Fierro. 2011. Border Delays and Economic Impact to The Freight Sector: An Exploration of the El Paso Ports of Entry. El Paso: Center for International Intelligent Transportation Research. https://tti.tamu.edu/wp-content/uploads/2013/08/CIITR_Economic-Impacts-Freight__Report_09.pdf

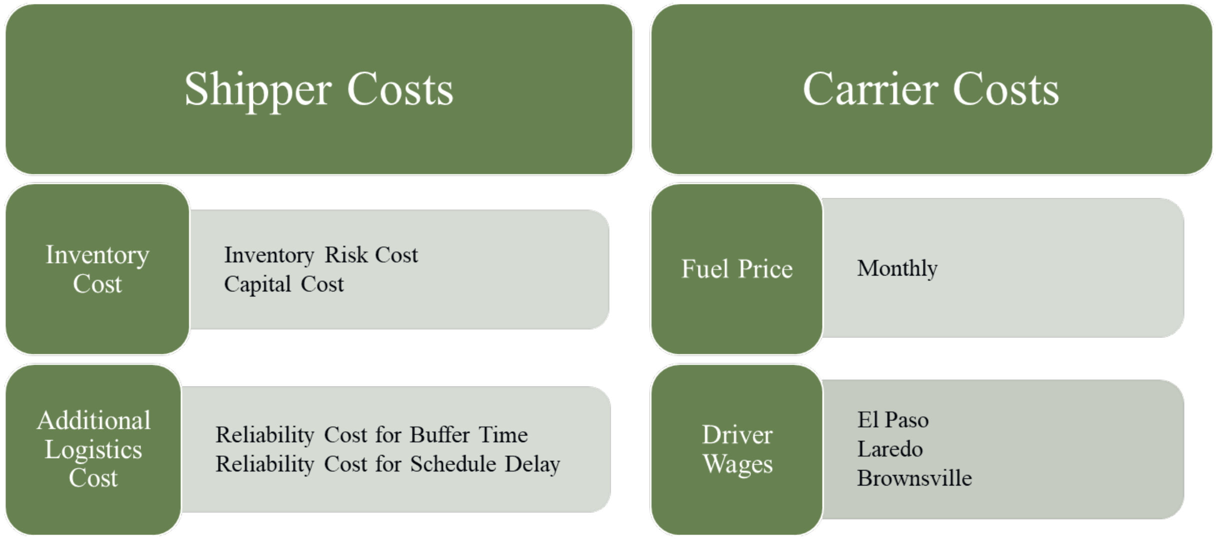


Figure 17. DCET Costs.

Additional logistic costs under shipper costs included reliability cost for buffer time and reliability cost for schedule delay. The reliability cost for buffer time was set at $168.53 per hour for both just-in-time and perishable commodity groups. Meanwhile, the reliability cost for schedule delay was equal to $371.33 per hour for the just-in-time commodity group.

The carrier costs are mainly composed of fuel price and driver wages, which were updated monthly for the analysis. Driver wages were entered separately for each region throughout the analysis period. Other operating costs related to carrier costs were estimated at $4.84 per hour, and the commercial vehicle fuel consumption rate was estimated at 4 gallons per hour. For more information of the costs, please visit the Aldrete et al.[2] and Vadali et al. report.[8]

3.2 ANALYSIS PROCESSES

In order to produce results, the DCET calculates several key processes including delay costs, average delay, and the number of trucks suffering delay. These processes are used to generate daily, monthly, and annual values.

3.2.1 Delay Costs

Delay costs are split into shipper and carrier expenses, such as Inventory Costs, Additional Logistics Costs, Carrier Costs, and Operating Costs. These costs are calculated for both loaded and empty trucks, and the delay costs for loaded trucks are calculated for all commodities. Just-in-time shipments, which are more time-sensitive, have an additional daily cost attributed to schedule delay by the 95th percentile crossing time. All delay costs are combined to produce a final cost per hour.

3.2.2 Average Delay

The researchers defined "free flow crossing time" as the 10th percentile of crossing time samples. This is because border crossings are never truly free-flowing due to customs, immigration, and safety inspections. The 10th percentile was chosen as a proxy for the shortest realistic crossing time that can be achieved while still accounting for vehicle inspections. Delay is defined as the amount of time commercial vehicles exceed the free flow crossing time when crossing the border. Average delay is calculated by subtracting the free flow crossing time from the average northbound crossing time above the free flow crossing time. The result is expressed in hours.

3.2.3 Number of Trucks Suffering Delay

This is calculated by determining the percentage of trucks that experience northbound crossing times above the 10th percentile (i.e., the trucks experiencing a delay). This percentage is applied to the number of northbound commercial vehicles crossing the border per day, per commodity type. The number of delayed trucks per commodity is combined to create a final value used in the calculations.

3.3 ANALYSIS OUTPUTS

In this section, the results of the direct cost of northbound delay estimated by the DCET for the selected border crossings are presented. The researchers used the tool to estimate the costs for both FAST and standard lanes at six selected crossings using the data obtained for the year 2019. The tool was run on a monthly basis for each border crossing, resulting in a total of 144 runs. The tool has the capability to differentiate the results based on the shipper and carrier costs of delay. Therefore, in this report, the researchers first provide the outputs separately and then combine them in the following sections for a comprehensive analysis.

3.3.1 Shipper Direct Northbound Delay Costs

The following paragraphs provide information on the monthly total shipper costs for each border crossing as well as the annual average shipper cost of delay per truck. The World Trade Bridge saw the highest volume of traffic, resulting in the highest estimated total shipper cost of delay at $84.5 million. Zaragoza and Colombia followed closely behind with estimated total shipper cost of delay of $32 million and $28.4 million, respectively (see Figure 18).

The World Trade Bridge had the highest volume of northbound truck traffic in 2019, resulting in the highest total shipper cost of delay of $84.5 million, with Zaragoza and Colombia closely following with total shipper costs of delay of $32 million and $28.4 million, respectively.

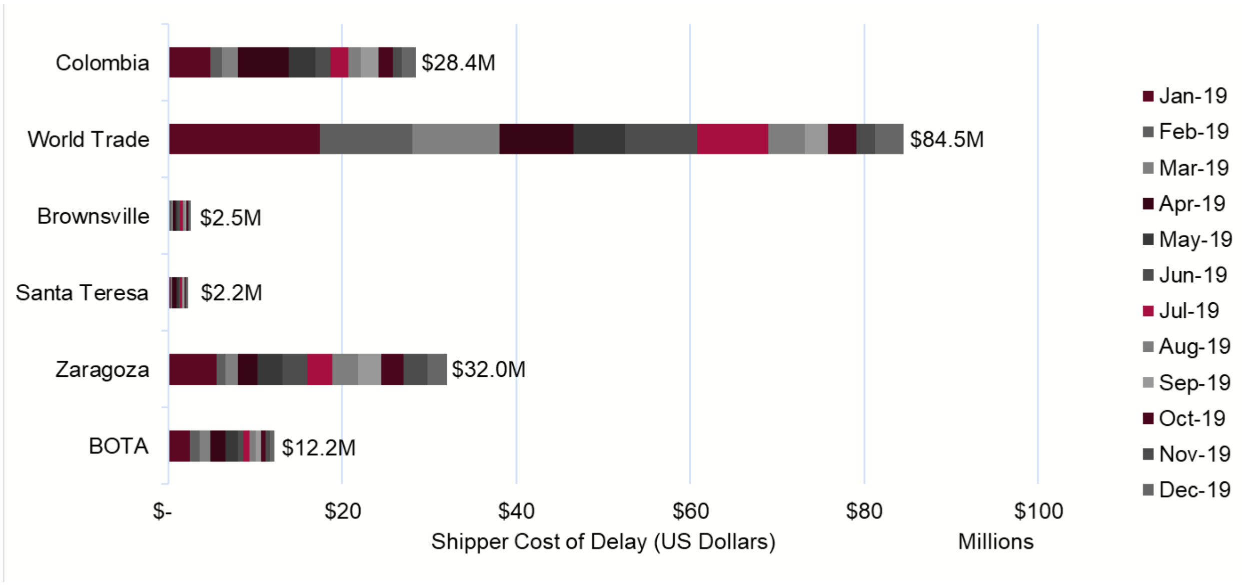


Figure 18. Shipper Cost of Northbound Delay by Border Crossing.

To evaluate the impact of commodity distribution and average cargo value, the average cost of delay per truck for shippers was calculated. This value represents the average shipper cost per truck for the year 2019, regardless of crossing volumes. As depicted in Figure 19, the highest cost of delay was observed at the Colombia border crossing, where shippers incurred an average cost of $138 per truck. The World Trade Bridge was the second-highest with $119 per truck, followed closely by both El Paso ports (Zaragoza and BOTA) with $112 and $105 per truck, respectively. On the other hand, shippers at Brownsville and Santa Teresa border crossings had significantly lower costs per truck at $35 and $27, respectively.

El Paso has some of the most competitive costs of northbound delay per truck for shippers:

- **The cost of delay per truck was highest at the Colombia border crossing with $138, followed by the World Trade Bridge with $119.**
- **Zaragoza and BOTA had comparatively lower costs at $112 and $105, respectively.**
- **Brownsville and Santa Teresa had the lowest costs per truck at $35 and $27, respectively.**

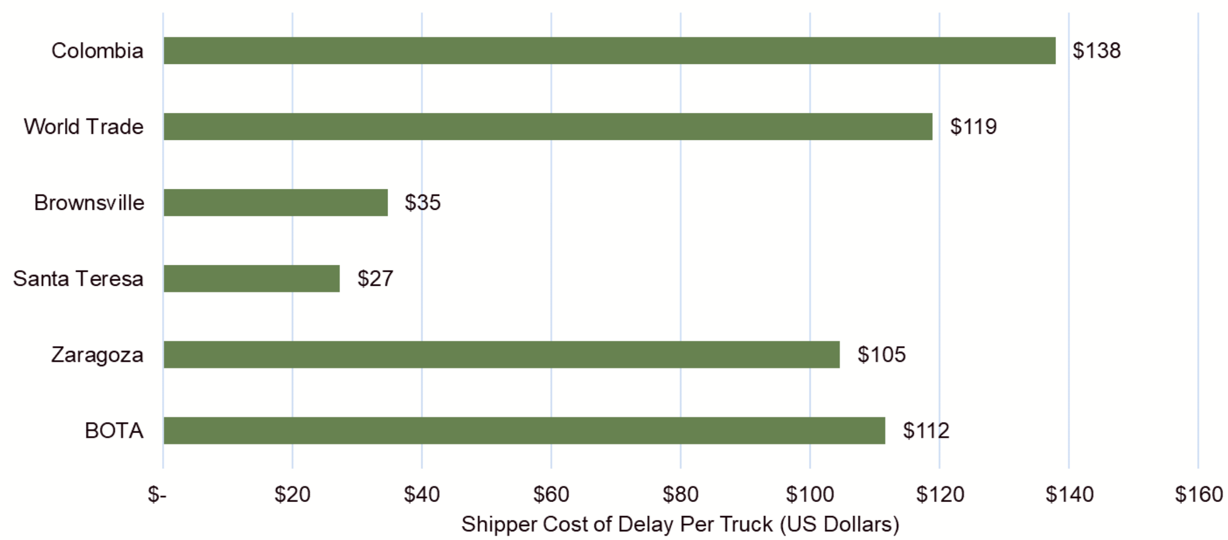


Figure 19. Shipper Cost of Delay Per Northbound Truck by Border Crossing.

3.3.2 Carrier Direct Northbound Delay Costs

The World Trade Bridge had the highest total cost of carrier northbound delay in 2019 with $61.4 million, followed by Zaragoza with $13.2 million and Colombia with $9.1 dollars.

The monthly calculations of carrier costs, which include fuel prices and driver wages for each selected border crossing, were conducted to estimate the total northbound delay costs for 2019. This time, empty trucks were also taken into account. The estimated total delay costs for each port are illustrated in Figure 20, with each row representing a port and different colors indicating the monthly contributions of the tool output. According to the results, the World Trade Bridge had the highest total cost with $61.4 million dollars, followed by Zaragoza with $13.2 million dollars and Colombia with $9.1 million dollars.

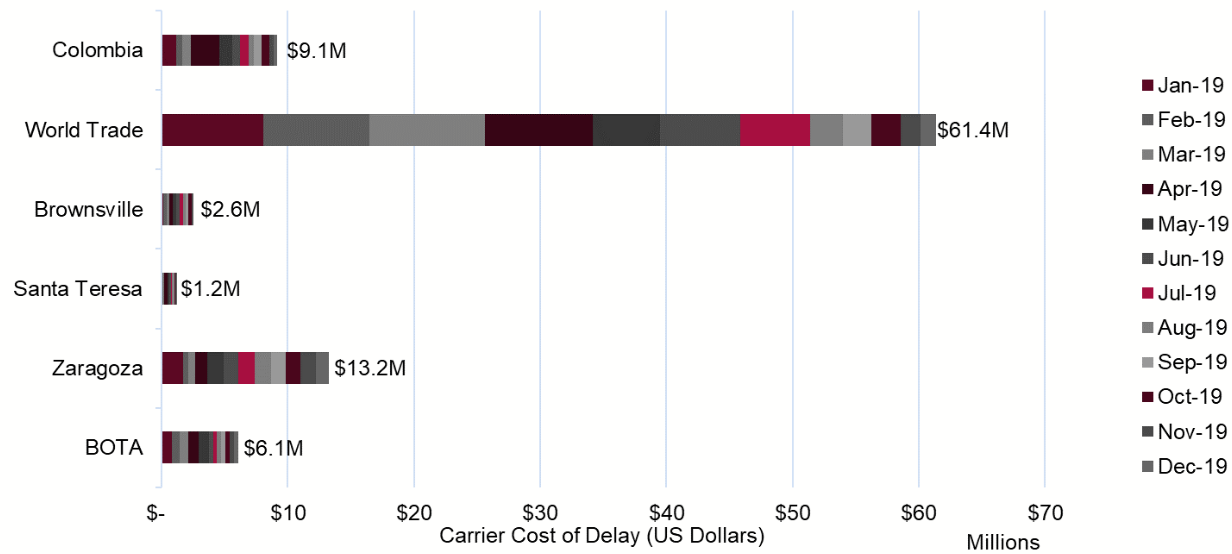


Figure 20. Carrier Cost of Northbound Delay by Border Crossing.

The average delay cost per truck for northbound carriers was also calculated, similar to shipper costs. Figure 21 illustrates the average cost for carriers at each border crossing. The highest average cost was observed at the World Trade Bridge, with $61 per truck, followed by BOTA with $44 per truck. Zaragoza and Colombia ranked third with the same estimated cost per truck for the carriers of $33 per truck.

El Paso has competitive carrier costs of northbound delay per truck compared to other regions:

- **The World Trade Bridge and BOTA had the highest average costs at $61 and $44 per truck, respectively.**
- **Zaragoza and Colombia ranked third with the same estimated cost per truck of $33.**
- **Brownsville and Santa Teresa had the lowest costs per truck at $18 and $13, respectively.**

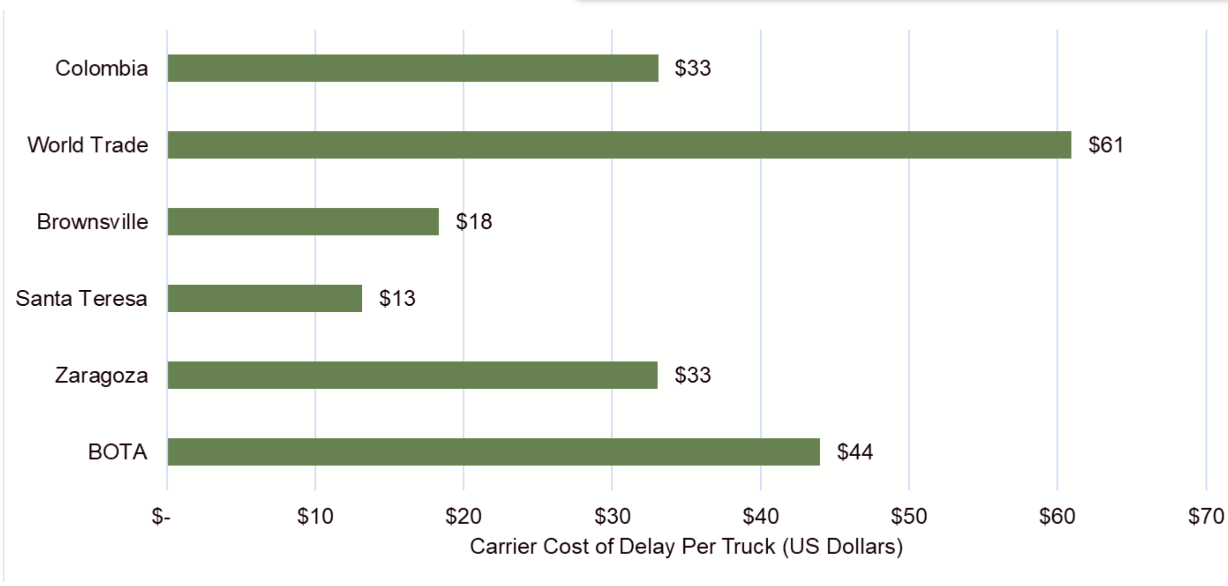


Figure 21. Carrier Cost of Delay Per Northbound Truck by Border Crossing.

3.3.3 Total Direct Northbound Delay Costs

- **The World Trade Bridge had the highest total annual cost of northbound delay in 2019 with nearly $146 million, followed by Zaragoza, Colombia, and BOTA.**
- **Brownsville and Santa Teresa had the lowest rates for the total direct cost of northbound delays.**
- **The trucks traveling in standard lanes delays accounted for most of the total direct cost of northbound delay.**

The direct delay costs for both FAST and standard lanes were calculated using the DCET for each port. Figure 22 presents the annual estimated cost of delay, which was highest at the World Trade Bridge at nearly $146 million. The Zaragoza Bridge had the second highest cost of delay at $45.2 million, followed by Colombia at $37.6 million, and BOTA at $18.3 million. In contrast, the lowest rates for the total direct cost of delays were observed at Brownsville and Santa Teresa border crossings, with $5.1 million and $3.5 million, respectively.

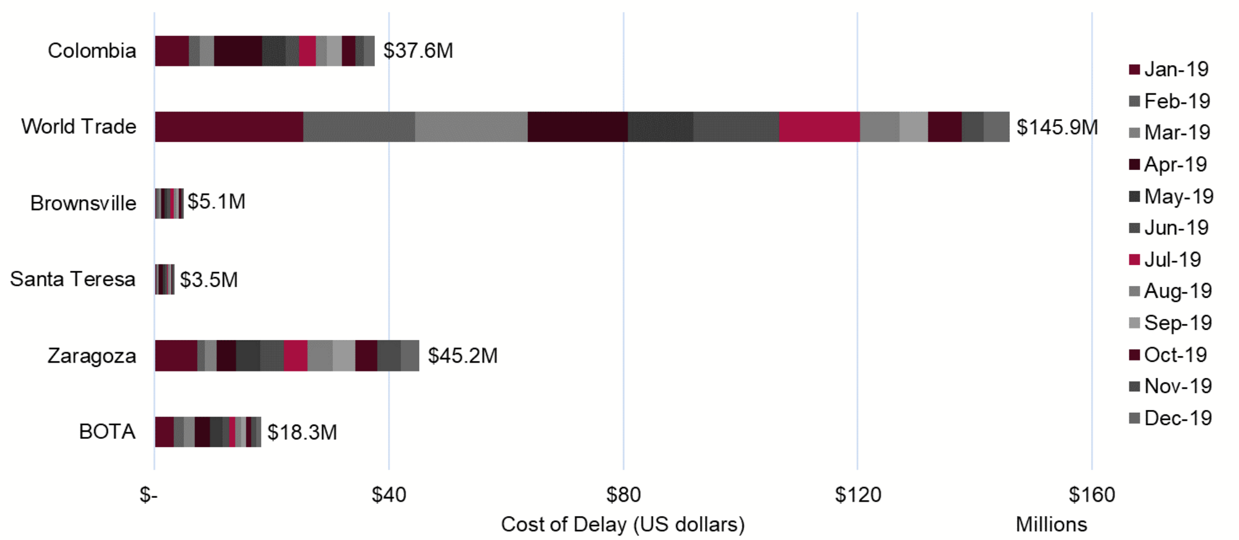


Figure 22. Total Direct Cost of Northbound Delay by Border Crossing.

As shown in Figure 23, standard lanes contributed the highest to total costs, fluctuating between 71 percent of total direct costs at the World Trade Bridge and BOTA and 80 percent at Brownsville.

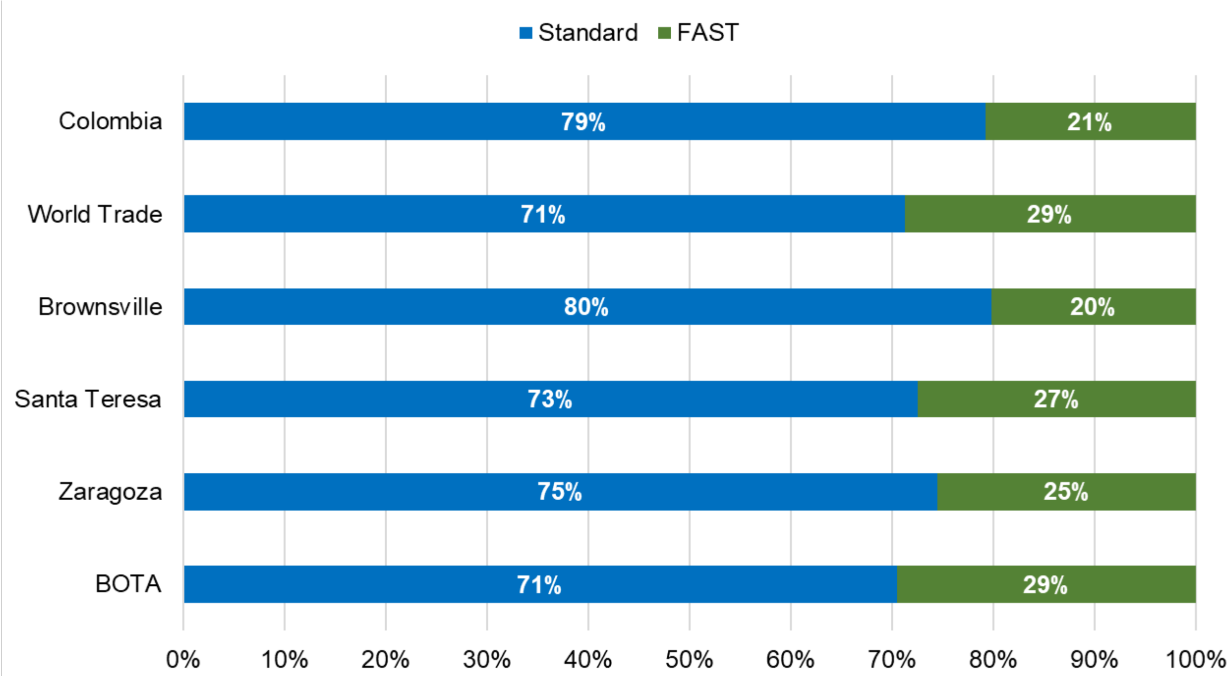


Figure 23. Total Northbound Cost Distribution between FAST and Standard Lanes.

3.3.4 Unit Average Direct Northbound Delay Costs

The unit average delay costs were over $500 per minute for each truck traveling northbound at Santa Teresa and the World Trade Bridge, likely due to their high average cargo value per truck for just in time commodities.

This section presents an alternative approach developed in the study called the unit average direct delay cost. This approach answers the question of what would happen if one truck experienced a delay of one minute. The DCET tool was used to analyze this scenario for each border crossing. The unit average direct delay cost was calculated separately for each port using the DCET tool by assuming that for one truck, only one minute of delay occurred. The crossing times and truck volumes were fixed while the commodity distribution, average cargo value, and costs were kept constant. Figure 24 displays the monthly findings of this approach for each border crossing. In contrast to previous findings, Santa Teresa had the highest average delay cost, closely followed by the World Trade Bridge, with both having over $500 for each truck. In other words, one minute of delay for one truck was estimated to have an average direct cost above $500 for Santa Teresa and the World Trade Bridge. Other crossings followed in order of Zaragoza, Colombia, BOTA, and Brownsville.

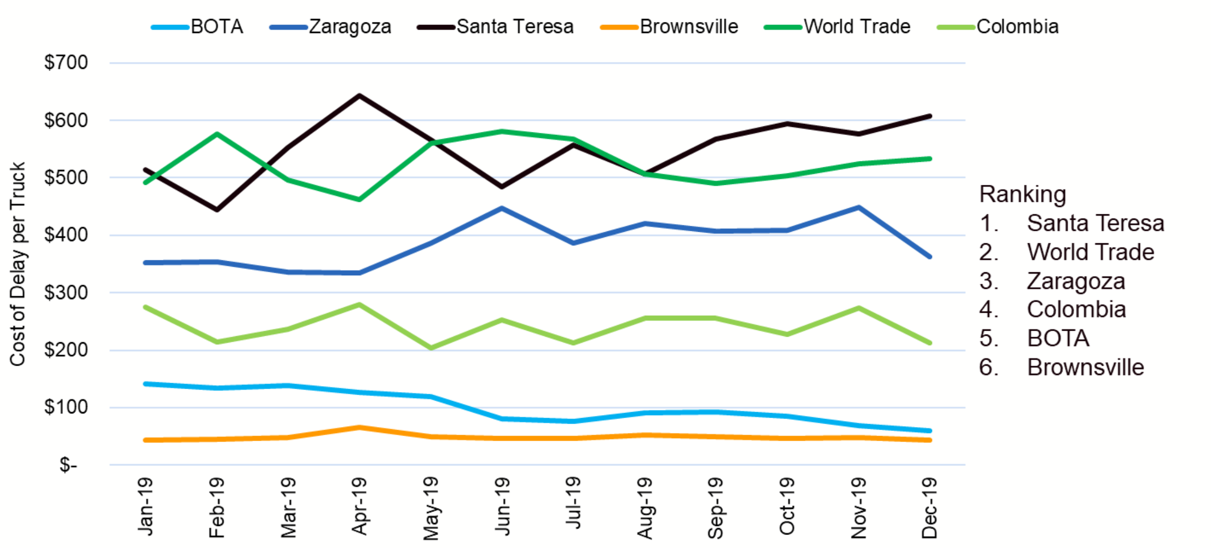


Figure 24. Unit Average Nortbound Cost of Delay by Border Crossing.

CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions and recommendations based on the analysis of the costs associated with northbound delays at selected border crossings along the Texas-Mexico border, with an emphasis on the implications for the El Paso MPO and regional border trade community stakeholders.

4.1 CONCLUSIONS

The study analyzed six border crossings along the U.S.-Mexico border and estimated the direct costs of northbound delay for commercial traffic across border crossings. The delays caused by increased truck traffic, multiple inspections, and suboptimal vehicle access configuration to the crossing negatively impact various stakeholders, the environment, and the economy. The study found that Laredo ports had three times the monthly truck volumes of El Paso region ports and eight times that of Brownsville. Although BOTA in El Paso had the highest average crossing times in 2019, the World Trade Bridge had the highest median crossing time for both FAST and non-FAST trucks, followed by Ysleta and BOTA. Santa Teresa experienced the lowest median crossing times among the border crossings in the study.

This study also revealed that, on average, there is not a significant difference in crossing times between the FAST and standard vehicle lanes. This finding undermines the anticipated advantages of expedited inspection for FAST commercial vehicles. The study found that inadequate access leading to the border crossing is a primary cause of delays for FAST trucks. The reason for this is that both standard and FAST vehicles use the same roads to approach the border crossing, and there are no dedicated travel lanes.

The costs of northbound delay were calculated for both shippers and carriers for the year 2019, with figures provided for the total cost for all trucks using each facility and for the average cost of each truck using each facility. On a per truck basis, the El Paso ports have some of the most competitive northbound costs of delay for shippers and carriers. Brownsville and Santa Teresa had the lowest costs per truck for carriers in the group.

Overall, these findings suggest that El Paso region ports, including Santa Teresa, have some of the most competitive northbound costs of delay per truck for both shippers and carriers, making it an attractive location for industry.

4.2 RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made for decision-makers and policymakers:

- Incorporate southbound commercial vehicle delay analysis for all truck crossings to gain a comprehensive understanding of delays and to identify potential solutions.
- Consider repeating the analysis with more recent data since the gap between Laredo and El Paso may have increased since 2019 and to keep up to date with changing trends.

- Promote the use of FAST lanes amongst shippers and carriers to reduce crossing times and improve efficiency.
- Provide tools and support for inspection agencies to enable them to operate at maximum capacity during peak hours to reduce wait times and minimize delays.
- Encourage shippers and carriers to shift their travel patterns from peak periods to off-peak periods to reduce travel demand during peak hours and improve traffic flow.
- Investigate options to improve FAST vehicle access on the access roadways leading to border crossings where access is found to be a limitation to realizing the full potential of the FAST program.
- Investigate options to add more capacity to handle peak hour demand in the future, such as expanding existing facilities or building new border crossings, to improve economic competitiveness and meet future demand.

APPENDIX

Table 1. Commodity Distribution Using HS Chapter Codes.[9]

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 electro-mechanical) 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, modelling 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 fur skins) and leather	
42	Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut).	
43	Fur skins 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; basket ware and wickerwork.	

[9] Bureau of Transportation Statistics. Codes for North American Transborder Freight Data. 2-Digit Commodity Code. https://www.bts.dot.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-and-data/transborder-freight-data/220171/codes-north-american-transborder-freight-raw-data.pdf

47	Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) 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; tufted 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; 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, seat-sticks, 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 semi-precious 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; cermet; 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, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like; prefabricated buildings.
95	Toys, games and sports requisites; 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, of fish or of crustaceans, mollusks or other aquatic invertebrates	
19	Preparations of cereals, flour, starch or milk; pastrycooks' products.	
20	Preparations of vegetables, fruit, nuts or other parts of plants.	
09	Coffee, tea, maté and spices.	**Non-perishables**
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 extracts.	
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 fodder.	
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	Temporary legislation; Temporary modifications established pursuant to trade legislation.	