

1. Report No. FHWA/TX-97/1319-6F	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle TRANSPORTATION ISSUES AND THE U.S.-MEXICO FREE TRADE AGREEMENT		5. Report Date February 1997	
		6. Performing Organization Code	
7. Author(s) Robert Harrison, Leigh Boske, Clyde E. Lee, and John McCray		8. Performing Organization Report No. Research Report 1319-6F	
9. Performing Organization Name and Address Center for Transportation Research The University of Texas at Austin 3208 Red River, Suite 200 Austin, Texas 78705-2650		10. Work Unit No. (TR AIS)	
		11. Contract or Grant No. Research Study 0-1319	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080		13. Type of Report and Period Covered Final	
		14. Sponsoring Agency Code	
15. Supplementary Notes Study conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration. Research study title: "Multimodal Planning and the U.S.-Mexico Free Trade Agreement"			
16. Abstract Eight reports were produced during the four-year duration of Project 0-1319. These reports are summarized below into three areas comprising policy issues, weigh-in-motion studies, and trade transportation forecasting research. <i>Policy Research:</i> The first study examined the transportation systems in Mexico and the U.S., together with plans for improvements or expansion and the opportunities and constraints faced by each transportation mode. A particular focus of the first report was the identification, collection, and categorization of Mexican intermodal data. The second report explored the demand for transportation services generated by regulatory changes and the implementation of NAFTA. These changes are challenging both shippers and carriers to seek out nontraditional transportation systems to create linkages to overcome obstacles originating from the structural and regulatory disparities between the two nations. The third and final policy study examined how these policies were creating new logistics practices and multimodal, binational transportation partnerships. <i>Weigh-in-Motion Studies:</i> Data obtained from two weigh-in-motion sites, one installed near the north end of the U.S. import lot at the City of Laredo (1993) and another at the Zaragoza Bridge in El Paso (1994), provide a unique source of information on the current characteristics of truck traffic at the Texas-Mexico border. Patterns of observed daily truck counts, truck types, and axle loads have been determined from 1993 through summer 1996. Equivalent single axle load (ESAL) factors have also been developed for each truck type. These data should help assess the current and future impacts of border-crossing traffic on the highway infrastructure in Texas and on other trade routes throughout the U.S. Finally, experience gained in installing and operating these systems will be of use in the implementation of future border weigh-in-motion systems. <i>Trade Transportation Forecasting:</i> Freight demand forecasting is central to agencies responsible for the highway infrastructure in both countries and to users developing trade transportation partnerships in an effort to improve efficiency. Specifically, the objective of the two reports was to use publicly available data to develop a predictive model for transportation mode and Mexican destination decisions for shipments traveling from various U.S. regions to Mexico. Aggregate logit models were calibrated for three commodities: machinery, electronics, and automobiles. The first study reviewed past efforts in freight demand forecasting, and a three-stage model was developed and tested using a sample of trade data provided by U.S. customs. In the second report, the publicly available data set contained aggregate shipments comprising origin, destination, commodity type, mode of transport across the border, and value. Destination attributes, such as population, employment, number of firms in the industry, and numbers of shippers and warehouses, were also included. Based on the results of this research, origin and commodity-specific models can be used to predict mode and destination choice. Both reports suggest improvements to currently available data sets that could enhance the performance of the freight forecasting models developed in this study.			
17. Key Words U.S-Mexico trade, Texas transportation infrastructure, NAFTA, multimodal planning, weigh-in-motion systems, border policy		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 57	22. Price

**TRANSPORTATION ISSUES AND THE U.S.-MEXICO FREE TRADE  
AGREEMENT**

by

Robert Harrison  
Leigh Boske  
Clyde E. Lee  
John McCray

**Research Report 1319-6F**

Research Project 0-1319  
*Transportation Issues and the U.S.-Mexico Free Trade Agreement*

conducted for the

**Texas Department of Transportation**

in cooperation with the

**U.S. Department of Transportation  
Federal Highway Administration**

by the

**CENTER FOR TRANSPORTATION RESEARCH  
Bureau of Engineering Research  
THE UNIVERSITY OF TEXAS AT AUSTIN**

February 1997



## IMPLEMENTATION RECOMMENDATIONS

In this report, implementation issues from the eight previous reports are grouped according to policy studies, weigh-in-motion operations, and trade transportation forecasting.

*Policy Studies:* U.S.-Mexico trade impacts should be evaluated from a binational, origin-to-destination, systems-flow perspective. New logistics practices should not only be viewed in the form of intermodal solutions, but rather as the development of transportation options responding to the changing bilateral trade environment. Advanced logistics influences transportation systems by facilitating industry-wide partnerships and new international agreements between shippers, transport companies, and clients. TxDOT and federal planning in the transportation sector should explicitly recognize these stakeholders in the international trade process.

*Weigh-in-Motion Operations:* The data obtained from the two weigh-in-motion (WIM) study sites provide a unique source of information concerning the characteristics of truck traffic at the Texas-Mexico border. The data should be used to help assess the current and future impact of border-crossing traffic on the operation and maintenance of highway infrastructure in Texas. Valuable information concerning overloaded trucks is available and should be used in developing appropriate enforcement programs, especially as they relate to NAFTA-induced traffic. Experience gained in procuring, installing, operating, and maintaining the two WIM systems for this project should be applied to future WIM sites.

*Trade Transportation Forecasting:* Freight demand forecasting can assist transportation professionals in planning the infrastructure maintenance required to offset serious disruptions to NAFTA-driven U.S.-Mexico trade. A predictive model for transport mode and Mexican destination decisions for shipments traveling from various U.S. regions was developed using publicly available data. Aggregate logit models have been calibrated for three commodities: machinery, electronics, and automobiles. Based on the results of this research, origin and commodity-specific models may be used to predict mode and destination choice. The methodology and results of this research may be applied to future studies to develop forecasting tools that include additional modes and commodities and which will be able to forecast decisions at a more disaggregate level.

Prepared in cooperation with the Texas Department of Transportation and the  
U.S. Department of Transportation, Federal Highway Administration

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BIDDING, OR PERMIT PURPOSES

Robert Harrison  
*Research Supervisor*

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## SUMMARY

Eight reports were produced during the four-year duration of Project 0-1319. These reports are summarized below in terms of policy issues, weigh-in-motion studies, and trade transportation forecasting research.

*Policy Issues:* The first study examined the transportation systems in Mexico and in the U.S., together with plans for improvements or expansion and the opportunities and constraints faced by each transportation mode. A particular focus of the first report was the identification, collection, and categorization of Mexican intermodal data. The second report explored the demand for transportation services generated by regulatory changes and the implementation of NAFTA. These changes are challenging both shippers and carriers to seek out nontraditional transportation systems to create linkages to overcome obstacles originating from the structural and regulatory disparities between the two nations. The third and final policy study examined how these policies were creating new logistics practices and multimodal, binational transportation partnerships.

*Weigh-in-Motion Studies:* Data obtained from two weigh-in-motion sites, one installed near the north end of the U.S. import lot at the City of Laredo (1993) and another at the Zaragoza Bridge in El Paso (1994), provide a unique source of information on the current characteristics of truck traffic at the Texas-Mexico border. Patterns of observed daily truck counts, truck types, and axle loads have been determined from 1993 through summer 1996. Equivalent single axle load (ESAL) factors have also been developed for each truck type. These data should help assess the current and future impacts of border-crossing traffic on the highway infrastructure in Texas and on other trade routes throughout the U.S. Finally, experience gained in installing and operating these systems will be of use in the implementation of future border weigh-in-motion systems.

*Trade Transportation Forecasting:* Freight demand forecasting is central to agencies responsible for the highway infrastructure in both countries and to users developing trade transportation partnerships in an effort to improve efficiency. Specifically, the objective of the two reports was to use publicly available data to develop a predictive model for transportation mode and Mexican destination decisions for shipments traveling from various U.S. regions to Mexico. Aggregate logit models were calibrated for three commodities: machinery, electronics, and automobiles. The first study reviewed past efforts in freight demand forecasting, and a three-stage model was developed and tested using a sample of trade data provided by U.S. customs. In the second report, the publicly available data set contained aggregate shipments comprising origin, destination, commodity type, mode of transport across the border, and value. Destination attributes, such as population, employment, number of firms in the industry, and numbers of shippers and warehouses, were also included. Based on the results of this research, origin and commodity-specific models can be used to predict mode and destination choice. Both reports suggest improvements to currently available data sets that could enhance the performance of the freight forecasting models developed in this study.





## **CHAPTER 1. INTRODUCTION**

Project 0-1319 has focused on multimodal planning in the context of the North American Free Trade Agreement (NAFTA) and the role this might have in international trade movements along the Texas-Mexico border. The dynamic nature of these movements, influenced by the lowering of tariffs, macro-economic changes in both countries, new industries, new transportation modal partnerships, the growth of logistics management, the unilateral postponement of specific NAFTA agreements, and the peso devaluation, all combined to change the original focus of the project. Accordingly, the study was extended an additional year in order to address some of these impacts.

The eight reports published under this project cover a range of policy, truck and trade flow, and forecasting subjects. This executive report describes the terms of reference for the study, the methodologies employed in different areas, the reports published as products of the study, and recommendations for further research. It also contains an appendix that identifies NAFTA-related highway corridors in the United States.

### **BACKGROUND**

Growth in U.S.-Mexico trade over the decade following Mexico's joining the General Agreement on Tariffs and Trade (GATT) in 1986 has been dramatic, with the traditional range of agricultural and mineral products supplemented by rapid increases in electrical and automotive equipment produced at maquiladora and continental sites within Mexico. Mexico is now the second-largest U.S. trade partner, with total annual exports and imports exceeding \$140 billion, a sum rivaled only by Canada, the third member of the North American Free Trade Agreement.

Because a substantial portion of nonpetroleum joint trade moves through Texas, the state has accrued both benefits and costs. In terms of benefits, binational trade has stimulated growth in border cities and has increased employment opportunities throughout the state. At the same time, it has also adversely impacted the infrastructure in South Texas, an area that was traditionally weak in this regard (when compared with other regions of the state). Although the need for improving all border infrastructure has been intensifying for some time, the increased trade has imposed additional and distinct pressures on highways, both within border cities and across the southern region of Texas.

### **TXDOT RESEARCH STUDIES**

Prompted by the increase in surface freight moving through the state (e.g., 1.2 million loaded trucks and 250,000 loaded rail cars entered the state in 1991), TxDOT has begun to develop policies to mitigate the more adverse impacts of trade growth on the state's transportation infrastructure. An important element of such policy development has been TxDOT's sponsorship of NAFTA-related research through its Cooperative Research Program. Thus in 1992, a study to measure the impact of international truck traffic on the Texas roadway network (Ref 1) was undertaken by the Texas Transportation Institute (TTI). That study in particular focused on traffic

generated from the maquila industries along the Texas-Mexico border and on the potential impacts of the then-proposed NAFTA. Aspects of the current NAFTA were already in place (the Canadian and U.S. agreement had been signed in 1989), but it was assumed that the full NAFTA would further stimulate trade and, as a consequence, impose even more stress on highway infrastructure. A second study (Ref 2) was undertaken by CTR later in 1992 to address truck impacts and issues at Laredo, a key trade gateway on the U.S.-Mexico border. That study's reports covered border issues at Nuevo Laredo — highlighting the significance of binational planning — and trucking impacts within the City of Laredo and its economic environs.

Subsequently, in the FY 1993 TxDOT Cooperative Research Program, CTR undertook a study on multimodal planning and NAFTA (Ref 3); a companion study on the impact of NAFTA on the Texas highway network was undertaken by TTI (Ref 4). The CTR study — Project 0-1319 — is the subject of this executive report. Furthermore, as part of the 1992 Intermodal Surface Transportation Efficiency Act (ISTEA), a federal study was commissioned to examine the impact of NAFTA flows on U.S. border and state infrastructure (Ref 5). It was hoped that the results of these research efforts would form a variety of planning databases and provide information for the determination of policies that could help TxDOT address the issues of trade transportation infrastructure.

## **STUDY 1319 TERMS OF REFERENCE AND MODIFICATIONS**

The specific objectives of the 0-1319 study were comprehensive and challenging. They included:

1. developing a series of scenarios covering the most likely impacts of NAFTA, with such scenarios then used to forecast traffic and passengers and to estimate transportation costs;
2. surveying existing facilities of all modes in Mexico and Texas, including access and connectivity across modes to develop potential sites and configurations for multimodal centers;
3. supplementing origin and destination data contained within the published commerce data with new data obtained from a WIM system installed at a key border crossing; this aspect of the study was to provide truck weight and axle load data required for Texas highway engineering evaluations;
4. assessing the degree to which highway traffic could be diverted to existing rail, air, and sea facilities, developing a true multimodal policy that could support continuing growth in U.S.-Mexico freight transportation;
5. evaluating the impact of NAFTA, together with a prediction of short- and long-term impacts on the volume of truck and passenger traffic moving along major corridors in Texas to permit the determination of levels in new investment in other modes, as well as to identify critical bottlenecks in the highway infrastructure; and
6. exploring mechanisms for coordinating binational transportation planning for all modes and evaluating existing mechanisms for financing highways and other transportation infrastructure on both sides of the border.

Study 1319 progressed along two fronts: The first focused on trade and NAFTA-related transportation issues, looking in particular at the Mexican market that had been largely ignored in previous work; the second involved installing a northbound WIM system at the Laredo port of entry. The study was modified in 1993 in two ways. First, a second WIM system was installed at El Paso to monitor both northbound and southbound truck traffic. Since Laredo was a port concentrating on trade with continental Mexico, we anticipated that monitoring truck movements at El Paso would capture the maquila trade and so complement the larger, continental truck-trailer movements through the port of Laredo. Second, the study team was directed to determine the causes for changes in logistics and shipping practices in U.S.-Mexico trade, and to evaluate the challenges of modeling trade flows and modal choice.

Finally, in 1995, the 1319 study was extended for a further year to address additional objectives, namely:

7. continue WIM data gathering at both the Laredo and El Paso sites;
8. assess the impacts of the Mexican peso devaluation on truck flows across the Texas-Mexico border;
9. identify the impacts of transborder movement following the second phase of NAFTA, due December 18, 1995; and
10. collaborate with Mexican researchers undertaking border studies to develop the potential for new planning data bases.

## **EXECUTIVE REPORT STRUCTURE**

This executive report summarizes the work undertaken and reported by the CTR team. It comprises sections on the methodologies used by the different study teams, the various reports produced under this study, recommendations, and, finally, the potential for future research. It also contains an appendix assessing U.S. highway corridors carrying U.S.-Mexico trade, which is of particular interest to Texas planners and which was prepared by Dr. John McCray of The University of Texas at San Antonio (UTSA), a consultant to the CTR team.



## **CHAPTER 2. METHODOLOGIES**

We followed a variety of methodologies in addressing the wide range of subjects relevant to Study 1319. These are summarized in three main categories: (1) studies related to the LBJ School of Public Affairs; (2) studies related to the WIM systems at Laredo and El Paso; and (3) forecasting studies focused on freight traffic, trade flows, and modal choice between the U.S. and Mexico. More detailed information on methodologies is contained in the series of individual reports described in the next section of this report; only the salient features are now summarized.

### **POLICY RESEARCH PROJECT REPORTS**

These projects were conducted at the Lyndon B. Johnson School of Public Affairs, a University of Texas institution that has established interdisciplinary research on policy problems as the core of its educational program. A major part of this program is the nine-month Policy Research Project (PRP), in the course of which faculty members direct the research of graduate students of diverse backgrounds on a policy issue of concern to a federal or state government agency. This brings students face-to-face with administrators, legislators, and other officials active in the policy process and demonstrates the difficulties in relating research findings to the world of political realities.

Study 1319 was an ideal candidate for the PRP process. It covered binational trade agreements, processes instituted at both state and federal levels in both Mexico and Texas, and focused on the impacts of the trade agreement on transportation flows and its effect on a key Texas state agency. Accordingly, the PRP process was used extensively during the first three years of the study to examine a wide range of subjects, including multimodal transportation (with particular focus on Mexico), corridors, logistics practices and multimodal partnerships, and U.S.-Mexico transportation systems.

The graduate students first conducted a general literature review. The team, comprised of students and participating faculty, then crafted a program of primary research that involved communicating with researchers and individuals in the transportation community in both the U.S. and Mexico. This communication took the form of letters, faxes, telephone interviews, and personal visits. Some specialists traveled to Austin to give presentations, and a substantial travel program, both within the U.S. and in Mexico, was organized to contact individuals in their offices. In this way, contact was made with transport agencies, modes responsible for the movement of international trade, and shippers and logistics corporations on both sides of the border. As information was collected and drafted, the team met weekly under the direction of participating faculty to develop draft versions of each report. Final versions were reviewed, whenever possible, with the specialists providing the initial material in order to ensure accuracy and completeness.

### **WEIGH-IN-MOTION REPORTS**

Weigh-in-motion systems perform two distinct operations: (1) they detect the presence of a passing vehicle and measure corresponding dynamic tire forces with respect to time and location,

and (2) they interpret the dynamic-force measurements to produce estimates of static wheel and axle loads, gross vehicle weight, vehicle speed, axle spacing, and vehicle classification by axle configuration. A certain degree of pavement smoothness is required to insure the validity of WIM data, as described in standards established by the American Society of Testing Materials (ASTM) in 1990. In Laredo the site chosen for the WIM system — near the U.S. import lot — proved to have inadequate pavements. In order to meet the pavement smoothness specification for the system, the City of Laredo replaced a segment of the westbound lane with a 0.3-m (12-inch) continually reinforced concrete pavement over a length of 60 m, in compliance with ASTM smoothness standards. Once this section was rebuilt, the only significant shortcoming was the lack of a readily accessible telephone line required for remote monitoring of the system and the retrieval of data. The telephone line and electric power were subsequently provided by the City of Laredo.

The system chosen for both Laredo and El Paso was a PAT Equipment Corporation DAW100 package, a reliable and easily installed system that TxDOT was already familiar with. The Laredo system was commissioned in early October 1993 and was calibrated using a three-axle TxDOT calibration truck with known axle loads, gross vehicle weight, and axle spacings. Follow-up calibrations conducted in early December 1993 using a four-axle tractor-flatbed combination revealed that only minor corrections were needed. Another calibration using TxDOT's five-axle calibration truck in 1995 yielded similar results.

The system at El Paso was more complex in that it measured both northbound and southbound truck movements through the Zaragoza port. Fieldwork for the site installation completed in February 1994 showed that there were unacceptably high levels of surface roughness in the areas where the WIM sensors would be installed. Accordingly, a subcontract was granted to a concrete-cutting contractor to level the surface to ASTM standards. The grinding procedure was entirely successful, and the installation of the four bending-plate tire force transducers was performed by a TxDOT crew in May 1994. Like Laredo, regular calibration exercises have been undertaken to maintain the integrity of the system. However, unlike Laredo, a specific problem in El Paso arose because of vehicles queuing over the WIM site. This occurred at peak periods when the toll collection at the bridge was unable to meet the demand, causing trucks to back up over the WIM pad.

To overcome this problem, specifications for new software capable of handling data from queues were developed, together with an auxiliary vehicle detector which was integrated into the southbound sensor system. The difficulties at El Paso precluded continuous data collection over the entire research study period, though large representative samples of data collected during the period 1994 to 1996 were analyzed to define daily and monthly patterns of truck counts and axle loads, and to identify changes in these patterns over time. In this regard, the methodology entirely met the basic planning needs of TxDOT with respect to the analysis of international traffic at both ports of entry.

## **FORECASTING STUDIES**

In the first study, a methodology was evaluated for determining the impact of the North American Free Trade Agreement on truck flows at the border. The methodology comprised three

separate components used to forecast freight demand between Texas and Mexico. First, an input/output method was used with interregional and dynamic enhancements to provide estimates for the commodity flows between industries and regions. Second, a modal choice model was developed for each commodity group based on transportation, shipment, and commodity attributes. Third, firm surveys and shipment size data were used to develop a profile of how firms determined shipment size. These were then combined to estimate vehicle flows associated with trade across the international border.

A second study examined model specification using an aggregate logit model approach. These study data, provided by the U.S. Bureau of Census, were collected through shipper export declarations, the Automatic Broker Interface, and Customs entry documents for trade moving between the U.S., Canada, and Mexico. By using the shipment decisions revealed in these data, we developed a discrete choice model in an attempt to forecast choices of shipment destination and mode of transport. The report developed a model structure after describing the theoretical framework for multidimensional choice and properties of discrete choice models. In both reports, the major constraints to the use of appropriate modeling proved to be the limitations associated with the available database; recommendations are made to overcome this current shortcoming.





## CHAPTER 3. STUDY 1319 REPORT SUMMARIES

### INTRODUCTION

This chapter highlights the important findings reported in the documents that have been submitted as part of this research effort. Included are both the Policy Research Project (PRP) reports prepared by the LBJ School of Public Affairs and the more standard TxDOT reports prepared by CTR.

#### **Policy Research Report 104 (Ref 6)**

##### ***Texas-Mexico Multimodal Transportation***

This report asserts that the extent of the trade benefits accruing to Texas under NAFTA depends heavily upon the infrastructure linking Canada, Mexico, and the United States. It examines the transportation system already in place, the various plans for improvements or expansion, and the opportunities and constraints faced by each transportation mode, namely, trucking, rail, maritime, and air. A particular focus of the study is the identification, collection, and categorization of Mexican intermodal data.

#### **Policy Research Project 109 (Ref 7)**

##### ***Logistics Management and U.S.-Mexico Transportation Systems: A Preliminary Investigation***

This report explores the demand for transport services generated by regulatory changes and the implementation of NAFTA. It provides a preliminary investigation into the ways in which the growing transportation needs of the U.S. and Mexico are driving changes in infrastructure, modal agreements, and regulatory harmonization. Both shippers and carriers are being challenged to seek out nontraditional transportation systems in order to create linkages that overcome obstacles originating from a history of structural and regulatory disparities between the two nations. Through a case study approach, the report discusses new logistical patterns developing in response to the expanding trade opportunities in the bilateral trade environment.

#### **Policy Research Report 113 (Ref 8)**

##### ***U.S.-Mexico Trade and Transportation: Corridors, Logistics Practices, and Multimodal Partnerships***

This report provides a detailed investigation into the ways in which U.S. and Mexican firms are attempting to overcome the difficulties of cross-border transportation and distribution. In great part, this is occurring via partnerships, strategic alliances, and through other kinds of business ventures designed to facilitate cross-border transfers of technology, capital, and expertise. Through a case study approach, the report looks at how several firms involved in cross-border transportation and distribution are using these types of cooperative ventures to expand effectively and profitably into the markets opened in Mexico by NAFTA.

The report includes chapters describing U.S.-Mexico bilateral trade and transportation, the

evolution of logistics practices and intermodal partnerships in the U.S. and Mexico, and current examples of joint ventures and partnerships between U.S. and Mexican transportation firms to facilitate cross-border trade, encourage intermodalism, and increase the use of logistics management techniques and related technologies. In addition to examining the technologies currently being used, the report also provides a detailed look at the various methods professionals can use, both in the private and public sectors, to forecast how traffic and trade will be distributed among the various modes of transportation.

**Study Report 1319-1 (Ref 9)**

***Measurement and Analysis of Traffic Loads Across the Texas-Mexico Border***

This report describes axle load and gross-vehicle weight characteristics of Mexican-origin commercial trucks processed through the U.S. customs yard in the City of Laredo, Texas. Investigation of these characteristics particular to Mexican-origin trucks is a prerequisite to evaluating the potential damage to Texas highways posed by international trade traffic. Justifiable concern exists not just with the increasing volume of trade-related truck traffic, but also with the loads carried by Mexican-origin trucks. This study was facilitated by the installation of a WIM system at Laredo, the preeminent southwestern commercial truck port of entry.

Load summaries are presented on five basic truck classes (by axle count) and are based on the original Association of American State Highway and Transportation Officials (AASHTO) pavement damage relationships. Load characteristics of each basic class include: (1) load status (empty or loaded), (2) ESAL factors (ESALs per truck), and (3) distribution of axle loads and gross-vehicle weights. Histogram summaries are provided for axle-group loads and gross-vehicle weights having the greatest propensity for exceeding current U.S. legal load limits.

Finally, damage implications are explored for the hypothetical integration of Mexican-origin commercial traffic into the current Texas traffic population. The commercial traffic, though hypothetical, was typified by that currently crossing at Laredo, and by that typified in a 1991 Mexican truck weight survey.

**Study Report 1319-2 (Ref 10)**

***Forecasting Freight Traffic Between the U.S. and Mexico***

The North American Free Trade Agreement (NAFTA) prompted new interest in freight demand forecasting. With respect to those goods moving between the U.S. and Mexico by surface transport, a majority are transported by highway through Texas, California, New Mexico, and Arizona. Freight demand forecasting can assist transportation professionals in planning for the infrastructure maintenance required to avoid serious disruptions to trade flowing across the border.

The objective of this research is to use publicly available data to develop a predictive model for transport mode and Mexican destination decisions for shipments from various U.S. regions. Aggregate logit models have been calibrated for three commodities: machinery, electronics, and automobiles. A profile of Mexico and its industries is presented, along with a review of past efforts in freight demand forecasting.

The data set of aggregate shipments used in the model estimation is comprised of origin,

destination, commodity type, mode of transport across the border, and value. Destination attributes, such as population, employment, number of firms in the industry, and number of shippers and warehouses, are also included. Based on the results of this research, origin and commodity-specific models may be used to predict mode and destination choice.

**Study Report 1319-3 (Ref 11)**

***Heavy Vehicle Characteristics at the Laredo and El Paso Ports of Entry***

Truck traffic moving through Laredo and El Paso, Texas, includes a large portion of the total number of heavy vehicles entering Texas from Mexico. These trucks have considerable impact on the transportation infrastructure in Texas and in other states, and the additional traffic that will be affected by the pending implementation of provisions of NAFTA are of special concern. To obtain quantitative data regarding the number of such trucks and their axle loads, weigh-in-motion (WIM) devices were installed near the north ends of the international bridges that cross the Rio Grande at Laredo (1993) and at El Paso (1994).

Data obtained from these WIM systems through the summer of 1996 are presented in summary form in this report. Analysis of the data has been undertaken to characterize the observed truck traffic volume and composition, axle loads, and equivalent single axle loads (ESALs) for northbound trucks entering the U.S. from Mexico at Laredo and at El Paso. A unique configuration of the two-direction WIM system at El Paso, where southbound trucks sometimes form queues over the WIM-system sensors, made it possible to also sample the characteristics of trucks with American trip origin before they crossed the Zaragoza International Bridge into Mexico. This report describes the performance characteristics of this WIM system, its installation, the calibration procedure, and its subsequent operation.

**Study Report 1319-4 (Ref 12)**

***A Methodology for Determining the Freight Border Transportation Impact of the North American Free Trade Agreement***

The demand for infrastructure investment in the Texas-Mexico border region, heightened by the growth in trade resulting from NAFTA, has created the need for a comprehensive freight forecasting model. Accordingly, this report presents a methodology useful in forecasting the effects of NAFTA on the demand for freight transportation at the Texas-Mexico border. In developing long-term estimates of future freight-related traffic crossing the border, the methodology employs three steps: (1) an economic analysis of the region, (2) calibration of modal choice models, and (3) an assessment of inventory practices. This methodology is designed to improve upon previous efforts by considering how NAFTA would alter the economic environment in which firms operate, as well as the decisions these firms make regarding modal choice and shipment size. By optimizing the efficient allocation of staff and resources, this methodology could be used to upgrade the operations and infrastructure of the Texas-Mexico border region.

**Study Report 1319-5 (Ref 13)*****Truck Traffic Characteristics at the Laredo and El Paso, Texas-Mexico Border***

A large percentage of the truck traffic crossing the Texas-Mexico border passes through Laredo and El Paso. To obtain statistical data regarding the number of types of border-crossing trucks at these ports, and specifically their axle loads, a WIM system was installed near the northern end of the truck bridges over the Rio Grande at both sites. Axle-load and axle-spacing data obtained from these systems for northbound trucks in both Laredo and El Paso between October 1995 and July 1996, and for southbound trucks only in El Paso between August 1994 and July 1996, are discussed.

Southbound trucks at El Paso were required to stop and pay Mexican bridge tolls at a station about 20 m beyond the WIM site, a requirement that frequently resulted in truck queues over the sensors. Consequently, it was often impossible for the WIM system to calculate axle spacing (as it is speed dependent). To address this problem, a supplementary infrared light beam, vehicle-present sensor was installed, and a special computer program was written to analyze the recorded axle-load data and recover implied information about axle and vehicle types. Seasonal patterns of truck counts, axle loads, and equivalent single axle load (ESAL) factors were studied. Comparisons were then made of the truck characteristics at each site.

## **CHAPTER 4. RECOMMENDATIONS**

### **POLICY STUDIES**

With respect to policy, a substantial effort within this study focused on capturing the Mexican dimension of the international trade flowing between the U.S. and Mexico. Based on this study's findings, we strongly recommend that the binational element of the trade flows be explicitly recognized in future research, and that monitoring of modal policies within Mexico, at both federal and state level, be maintained. New initiatives covering privatization of rail and port operations are likely to be critical in offering shippers new alternatives to the traditional land-based modes (modes that have resulted in many of the problems now seen along the southern border).

The trade moves over a distinct system of origins and destinations in which the border move is but one part. Future studies should recognize the importance of distinct international trade flows and should not simply concentrate on specific problems at individual ports of entry. Research conducted under Study 1319 has shown that the trade moves over distinct land corridors that are critical to both state and federal transportation planning. We therefore recommend the continued monitoring of these trade moves, and urge that models developed in this study be applied to new databases as they are formed by the Bureau of Transportation Statistics (BTS) and other federal agencies. As for Texas, we recommend the monitoring of highway, rail, intermodal, and maritime activities in order to address the needs of the Texas State Transportation Plan.

Border crossings are likely to remain a problem over the remainder of this decade. The postponement of the second phase of NAFTA has resulted in a move away from harmonized processes and toward a return to paired-city agreements and a more heterogeneous arrangement of border crossings. While borders are only one element in the trade flow, it is possible that a blend of infrastructure investment and institutional changes could, and will, improve efficiency in the next five years. Moreover, despite the attraction of special centers (supercrossings that will attract diverted trade to some extent if the efficiencies are worthwhile in terms of total trip times), the current system of border crossings in Texas is likely to hold for the immediate future. It is therefore necessary to recognize this feature in terms of TxDOT's regional planning and to insure that all crossing points are recognized in this process. Finally, research should continue into binational and state/federal institutional processes in an attempt to improve efficiencies and expedite trade flows for all modes.

### **WEIGH-IN-MOTION STUDIES**

U.S.-Mexico trade-related commercial truck traffic volumes are likely to continue their sizable growth rates, even while current transborder travel restrictions are in place. An accurate forecast of the commercial motor carrier growth rate is essential in allowing highway planners to develop meaningful damage projections. While increases in axle loads are an important consideration in assessing pavement damage, miscalculating traffic growth rates will have a far greater relative impact on pavement life.

The magnitude of heavier vehicle loads and their axle configurations are particularly salient

considerations in determining bridge overstress, where understanding the impact of a single “critical load” vehicle, or a multiple-presence incident, is essential to ensuring that critical bridge members are not overstressed. Additional study of potential Texas bridge damage caused by the integration of Mexican-origin heavy truck traffic into the overall Texas traffic population should be undertaken. Realistic traffic growth rate projections are needed not only to analyze fatigue costs, but also to identify “critical load” vehicles that can be used to assess overstress costs.

To minimize widespread degradation of Texas highway serviceability, the designation of special trade routes should be explored. Already, officials in counties bordering Interstate 35 are pushing for federal designation of a NAFTA “superhighway” in hopes of obtaining additional federal funding for anticipated upgrades. A similar designation may be appropriate for segments of Interstates 10 and 45 and for U.S. Highways 59, 77, and 281.

WIM systems provide a rapid and effective method for screening potential load-limit violators. Whether harmonization talks result in the U.S. retaining its lower legal load limits, or in raising load limits, WIM systems should be placed in the vicinity of each highway port of entry to screen for overweight violators. If designated trade routes are established, WIM systems could be used at major interchanges to screen traffic for violators traveling unauthorized routes. All WIM-system data should be recorded and analyzed continuously to establish trends in traffic loading at every site. Weight enforcement policy should be strict, with penalties based on such sound cost-recovery principles as assessing damage attributable by equivalent fatigue weight for bridge cost recovery and ESAL-miles (1.61 km = 1 mile) for pavement cost-recovery.

Border communities are already feeling the impact of increased traffic volumes and loads within the limits of their commercial zones. More effective cost-recovery practices should begin here. In particular, the cost-recovery studies performed by Said, combined with the loading distribution findings in this report, could be examined by Laredo officials to revise their current bridge toll strategy and to develop a more equitable fee schedule. Likewise, the damage to street pavements by heavy trucks should be evaluated.

Collection and interpretation of data from the Laredo WIM site should continue, with the objective of analyzing trends not covered in this report. Specifically, long-term and seasonal changes in commercial truck composition, volumes, and loading distribution should be monitored. Comparisons should also be made with data recorded at the Zaragosa site in El Paso, which was commissioned in June 1994.

## **FORECASTING TRADE TRANSPORTATION**

In this study, aggregate logit models for machinery, electronics, and vehicle commodity groups were estimated to model mode and destination choice jointly. The analysis of the U.S. export shipment data was conducted for U.S. and Mexican regions. Models were estimated for each commodity, first for each of the nine U.S. origin regions, and then for the entire U.S., with the origins pooled together. The data set was comprised primarily of export data of aggregated shipments from BTS. Supplementary data, such as distance and employment, were added to provide destination and modal attributes to determine the factors that influence the probability of a mode/destination choice.

The currently available data set variables were inadequate to model the influential factors in mode/destination choice. The results of the model estimation confirm the conclusions found in the literature review of past modeling efforts — namely, that mode, commodity, and market attributes are necessary for modeling freight decision-making behavior. Distance and market attributes are necessary to adequately capture influences on mode and destination choice. Average shipment value was a significant shipment characteristic for rail in predicting the likelihood of an alternative being chosen. In many cases, market attributes such as employment were significant variables in capturing mode-destination choice. The coefficient estimates using ordinary least squares were of the correct sign and significant. However, implementation of these models requires additional study in determining accuracy of the predictive ability (e.g., perhaps testing the models with recently released data).

With the origin-commodity specific aggregate logit models, a Poisson regression model could be calibrated for the frequency of shipments that would enable estimating the number of shipments going by each mode-destination alternative. If the number of shipments generated at each origin can be estimated, then interregional flows can be determined. For a more disaggregated analysis, models can also be specified for specific U.S. and Mexican states.

Some limitations to this work exist. Variables which have been found to affect mode choice and demand could not be included because the data were unavailable. Provided the data can be obtained, another variable which may be analyzed in future work includes transport system characteristics at both the origin and destination (i.e., mode accessibility). This type of attribute is particularly important for rail. Another attribute that could be included in the model specification is the cost for transport of the shipment by each mode. The more economical the rate, the more likely the mode is chosen for transport. However, commodity attributes (e.g., probability of loss and damage by mode, seasonality, whether the commodity is a bulk good) are also factors and should be included if data are available.

Another limitation in addition to the limited variables available for model calibration is the nature of the shipment data used in this analysis. Individual shipments have been aggregated by month, origin, destination, and mode because of the voluminous number of export shipments. If disaggregated data become available, a discrete choice model such as the nested logit model may be calibrated to model individual decision-making behavior. Furthermore, the aggregated shipment observations used in the estimation indicated only the mode of shipment across the border, and not whether transfers from other modes had been made (nor where they were made). Most likely shipments are not transported by one mode for the entire trip. Thus, the transport route would be of interest.





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**APPENDIX**

**IMPACT OF NAFTA TRUCK TRADE ON THE U.S. AND TEXAS HIGHWAY  
SYSTEMS**



# **IMPACT OF NAFTA TRUCK TRADE ON THE U.S. AND TEXAS HIGHWAY SYSTEMS**

by

**John P. McCray**

The University of Texas at San Antonio

July 1996

## **ABSTRACT**

With the implementation of the North American Free Trade Agreement (NAFTA), state highway departments, along with the federal governments of the U.S., Canada, and Mexico, have grown concerned over the impact of NAFTA-driven trade traffic on state highway systems in the U.S. Although there is growing recognition that trade between the U.S. and Mexico has a different impact on different U.S. state highway networks, and that this trade travels primarily along several well-defined U.S. highway corridors, research conducted by the U.S. federal government under the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) has failed to adequately define the impact on individual state highway systems or to define the highway corridors which transport U.S.-Mexico trade.

At the same time, advocacy groups for various highway corridor segments have requested additional funds for the highway corridors they represent, though at present they lack empirical evidence to support the location and significance of their corridors. Thus, this report describes research conducted to establish the state impact of NAFTA trade movements and the impact of truck-transported U.S.-Mexico trade movements on highway corridors in Texas and in the rest of the U.S. The research described in this report establishes a benchmark for assessing the impact of NAFTA truck movements on U.S. border states in terms of (1) the value of truck-transported trade with an origin or destination in each state and (2) the value of truck shipments that cross the border of each U.S. border state. The report also describes research which establishes the location of key U.S.-Mexico trade highway corridors in the U.S. and Texas. Trade corridors are shown in terms of the number of average-sized truck loads of U.S.-Mexico trade which travel the highway corridor yearly.

The dominant flow of truck-transported trade in the U.S. is shown to be primarily along the U.S. interstate highway system between the industrial northeastern U.S. and the Texas border with Mexico. Dominant U.S.-Mexico trade highways in Texas are shown to be I-35 from Laredo to Dallas/Ft. Worth, I-10 from the Texas/New Mexico border to the Texas/Louisiana border, I-20 from the I-35/I-20 intersection to Dallas/Ft. Worth, I-30 from Dallas/Ft. Worth to the Texas/Arkansas border, I-37 from San Antonio to Corpus Christi, U.S. Hwy. 59 (now designated I-69) from Houston to Laredo, U.S. Hwy. 281 from the intersection of U.S. Hwy. 281 and I-37 to McAllen, and U.S. Hwy. 77 from Victoria to Harlingen/Brownsville.



## **IMPACT OF NAFTA TRUCK TRADE ON U.S. STATES AND U.S.-MEXICO TRUCK TRADE IMPACT ON THE U.S. AND TEXAS HIGHWAY SYSTEMS**

### **BACKGROUND**

In recent years there has been a dramatic increase in transportation research relating to the commerce among Canada, the United States, and Mexico — its economic importance, its anticipated impacts across societies, and, of special significance to this report, the present and future demands that trade portends for U.S. and Texas highways on which trucks will transport that commerce. With the ongoing implementation of the North American Free Trade Agreement (NAFTA; Ref 1) political coalitions have formed to promote the various highway corridors along which the trade travels. Generally, these coalitions seek additional federal and state highway construction dollars for investment in the corridor being promoted, rationalized on the basis that the corridor is essential to the economic development projected to occur as a result of NAFTA. Most of these coalitions lack the resources to undertake the empirical analyses that would support their claims. This report describes the truck transport of U.S.-Mexico trade using well-developed origin and destination estimates to identify the physical locations of existing U.S. trade highway corridors and the truck-traffic densities resulting from that trade. It should be noted that this paper focuses solely on U.S.-Mexico commerce and its impacts on Texas and U.S. highways.

### **PREVIOUS RESEARCH**

McCray, in 1991 (Ref 2) and 1992 (Ref 3) identified the locations of U.S.-Mexico trade transportation corridors (rail and highway). Boske and Harrison, in 1993 (Ref 4), then determined the impact of the North American Free Trade Agreement on intermodal transportation. Under Section 6015 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA; Ref 5) the U.S. Secretary of Transportation was directed to conduct two studies relating to the movement of international trade. One of the specific purposes of these studies was to determine the location and importance of trade corridors (Ref 6). Surprisingly, however, this work neither identified those trade corridors nor determined their importance in terms of annual truck densities.

Recent work by McCray (Ref 7) locates the U.S.-Mexico truck trade corridors more precisely, while a separate study by Harrison in 1995 (Ref 8) examines the problems posed by overloaded trucks traveling on U.S. highways. Work by Boske and Harrison (Ref 9) examines the intermodal characteristics of U.S.-Mexico border transportation. This investigation extends the earlier work of McCray, Boske, and Harrison by presenting the physical locations of U.S.-Mexico trade highway corridors and by determining the volume of traffic on these corridors.

### **METHODOLOGY**

#### *Trade Data and Transportation Analysis*

All U.S. trade data are collected in the U.S. by the U.S. Customs Service (customs) for the purpose of collecting tariffs and controlling the movement of goods in accordance with U.S. law.



Customs collects this data at interior border crossings and at seaports and airports as goods are processed for export or import. In the case of U.S. exports, the most important determination is whether the goods can be legally exported. In the case of U.S. imports, the most important determination is the amount of tariff to be collected. Additional information is collected as part of customs processing, including information on commodity type, value, tariff, cost of insurance and transportation, weight, origin, destination, and mode of transportation. The types of data collected, however, are not the same for exports and imports; moreover, much of the data collected is not available to the public.

Agencies other than U.S. Customs, including the U.S. Department of Commerce and, recently, the U.S. Dept. of Transportation, publish subsets of the data collected by U.S. Customs. When analyzing U.S. trade data, it is important to realize that there are many different data sets, that the variables within these data sets are different, and that values for a variable within one data set do not necessarily agree with values for the same variable in other data sets. Yet combining research on trade transportation with commercial data collected by U.S. Customs can reveal transportation relationships.

Generally, the trade data collected for North American imports are more accurate than the data collected for exports. This occurs because there is a tariff on imports, which means that they are examined much more closely than exports. Also, U.S. export data on shipments to Canada are more accurate than U.S. export data for shipments to Mexico. This occurs because the U.S. now uses Canadian import data in place of U.S. export data for reporting purposes. Unlike Mexico, Canada also uses U.S. import data in place of its own export data for reporting purposes.

### ***Trade Data Analysis***

There are several sets of export and import data. Each set is developed for different purposes, but, as explained above, values for the same variable are usually the same in the different data sets. To produce the tables for this report, three different sets of U.S. trade data were used. These data sets include (1) U.S. export and import data contained on CD-ROMs produced by the U.S. Department of Commerce, (2) the export by state data furnished by the U.S. Department of Commerce, and (3) the transborder data collected by the U.S. Department of Transportation. Only the transborder data set reports ground-transported trade by transportation mode.

Although the values shown on the U.S. Department of Commerce CD-ROM and state of export data sets were in agreement, neither of these data sets were in agreement with the transborder data furnished by the U.S. Department of Transportation. Most of the trade data sets have been published in their present form for several years. An exception again is the newly created transborder data furnished by the U.S. Department of Transportation. The transborder data set has been evolving over the last two and one-half years, during which time specific variables within the data set have been changed. Significant errors in reporting within the data were uncovered in the analysis described above. Although the transborder data set can be expected to improve over time as collection criteria become more clear, the analysis of these data requires significant skill in trade transportation analysis. Work with the transborder data set involved time-

consuming comparisons of the ground trade flow with several other data sets with respect to origin and destination state to uncover inconsistencies and mistakes in the data. The search for errors required a port-by-port visual review of the data.

Data from the U.S. Department of Commerce were used to estimate the total exports and imports moving between the U.S. and Mexico. McCray Research has developed a proprietary procedure to estimate the dollar value and weight of trade shipments by mode of transportation, including a rail/truck percentage for land-transported goods. The database within this program includes shipments, by equivalent full railcar and full truck, from the U.S. state of origin to the border port, as well as from the border port to the destination, in more than 40 different commodity group classifications. The values in the database are derived from an analysis of statistics obtained from the United Nations (UN), the Organization for Economic Development and Cooperation (OECD), Statistics Canada, U.S. Department of Commerce, U.S. Department of Transportation, Mexican federal agencies, and from U.S. and Mexican border cities.

This research project required that the trade data be converted into reliable estimates of fully loaded truck trips, which was accomplished based upon previous analyses by McCray Research of truck loads involved in cross-border trade at several U.S.-Mexico border ports. One “trade truck” is defined as a fully loaded 14.6-m (48-foot) trailer. Actual truck crossings at these ports were analyzed (along with trade data) to determine conversion factors. The conversion factors were then used to estimate the number of equivalent 14.6-m (48-foot) trailer loads.

## **GROWTH OF U.S.-MEXICO TRADE**

An in-depth review of U.S.-Mexico trade flow, Mexican trade policy, and U.S.-Mexico trade forecasts are not within the scope of this report — nor are they essential to its understanding. However, a brief overview is presented to explain the rate of growth of U.S. Mexico trade flow in recent years and how the location of some highways has contributed to their emergence as dominant trade corridors.

Table 1 shows U.S. exports to and U.S. imports from Mexico from 1977 to 1994, the dollar amount of increase or decrease in annual trade flow, and the average annual growth over the period. As seen in this table, trade between the U.S. and Mexico has grown dramatically: In 1977 exports to Mexico were valued at \$4.82 billion while imports from Mexico were at \$4.77 billion; in 1994 exports to Mexico grew to \$50.84 billion while imports from Mexico soared to \$49.49 billion.

Prior to the 1980s Mexico was a closed economy, one that followed an import substitution policy. Under this policy Mexico maintained high tariff barriers in an effort to stimulate Mexican manufacturing while reducing dependence on foreign trade. Such a strategy evolved in response to an abundance of oil which was exported to create the necessary foreign exchange to protect the Mexican economy. When the world price of oil dropped dramatically in 1981 and 1982, Mexico’s oil could not be sold for enough dollars to buy the same amount of U.S. products that had been previously purchased. As a result of the oil crisis, Mexico was forced to devalue its currency (peso). During this time, as shown in Table 1, U.S. exports fell from \$17.79 billion in 1981 to \$9.08 billion in 1983.

*Table 1. 1977-1994 U.S.-Mexico trade and average annual export and import trade growth (billions of U.S. dollars)*

	<b>U.S. Exports to Mexico</b>	<b>Annual Change (Exports)</b>	<b>U.S. Imports from Mexico</b>	<b>Annual Change (Imports)</b>
1977	4.82		4.77	
1978	6.68	1.86	6.20	1.43
1979	9.86	3.18	9.00	2.80
1980	15.15	5.29	12.84	3.84
1981	17.79	2.64	14.01	1.18
1982	11.82	-5.97	15.77	1.76
1983	9.08	-2.74	17.02	1.25
1984	11.99	2.91	18.27	1.25
1985	13.64	1.64	19.39	1.13
1986	12.39	-1.24	17.56	-1.83
1987	14.58	2.19	20.52	2.96
1988	20.47	5.89	23.53	3.01
1989	24.97	4.50	27.59	4.06
1990	28.38	3.41	30.80	3.21
1991	33.28	4.90	31.89	1.09
1992	40.60	7.32	35.19	3.30
1993	41.58	0.98	39.92	4.73
1994	50.84	9.26	49.49	9.58
<b>Total</b>	<b>367.92</b>	<b>46.02</b>	<b>388.97</b>	<b>44.72</b>
<b>Average Annual Growth</b>		<b>2.71</b>		<b>2.63</b>

*Source of basic data: U.S. Dept of Commerce*

After the 1981 oil crisis, Mexico sought to become an internationally competitive country by changing its national policy of import substitution. Actions were taken which stimulated the growth of U.S.-Mexico trade. In 1986 Mexico joined the General Agreement of Tariffs and Trade (GATT), now called the World Trade Organization (WTO). The GATT/WTO has stimulated the growth of world trade by reducing tariffs and other trade barriers among trading partners. Under the GATT/WTO, Mexico removed many of its required trade permits and reduced tariffs. This resulted in a substantial growth of U.S.-Mexico trade, from \$12.39 billion of U.S. exports and \$17.56 billion of U.S. imports in 1986, to \$33.28 billion of exports and \$31.89 billion of imports in 1991, as shown in Figure 1. Trade growth has been further stimulated since 1991 by, first, the negotiations for the North American Free Trade Agreement (NAFTA) and, second, by the

implementation of NAFTA, which further reduced tariffs and other trade restrictions with the U.S. when it was implemented on January 1, 1994.

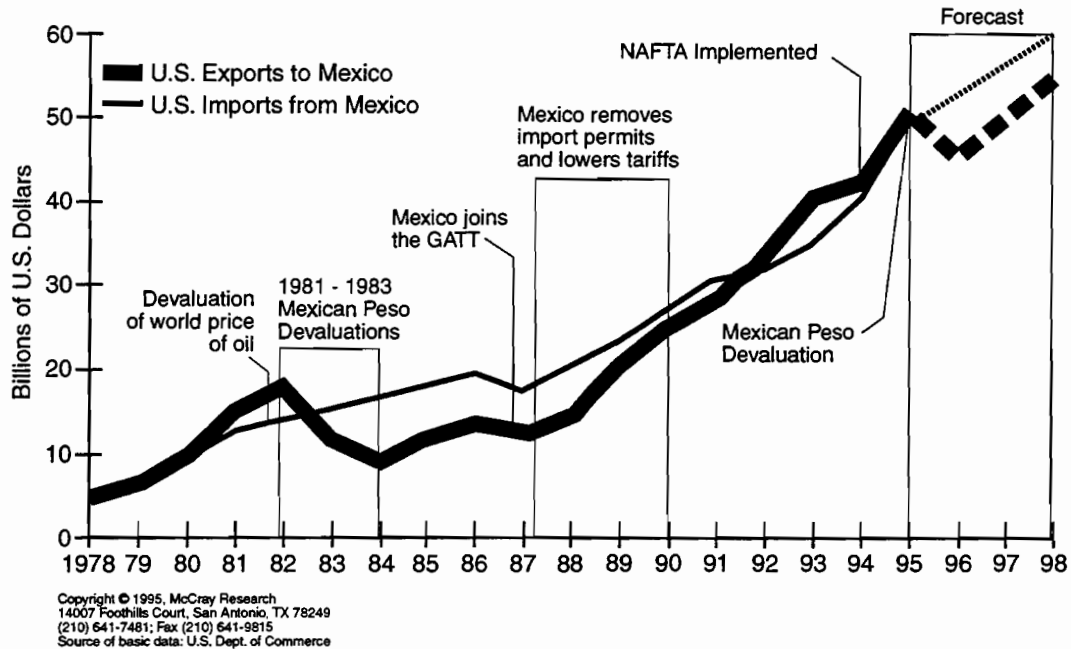


Figure 1. Growth in U.S.-Mexico trade

There was a substantial decrease in U.S. exports to Mexico during 1982 and 1983 following the devaluation of the peso. This is important to note because there was another major devaluation of the peso in December of 1994, which again caused a temporary decrease in U.S. exports to Mexico. The peso devaluation in December of 1994 has temporarily reduced the number of southbound U.S. trucks carrying exports, while the number of northbound trucks carrying U.S.-Mexico trade has grown significantly. During the first half of 1996, just as in the period following the devaluation in 1981-1982, imports from Mexico continued to increase while U.S. exports to Mexico have dropped.

### U.S.-MEXICO MODAL TRADE

Although this report focuses on U.S.-Mexico trade highway corridors, a breakdown of modal trade will be presented to give perspective to truck-transported trade.

Over \$100 billion worth of products was traded between the U.S. and Mexico in 1994. This was composed of more than \$50.8 billion of U.S. exports moving southbound, and over \$49.4 billion of U.S. imports moving northbound as shown in Table 2. On a dollar-value basis this trade flow is dominated at the present time by truck transport. In 1994 trucks transported an estimated \$41.5 billion of exports to Mexico and \$34.6 billion of imports from Mexico. Rail is the second most dominant mode, transporting \$4.6 billion of U.S. exports and \$7.6 billion of U.S. imports. Sea trade is the third most dominant mode, transporting \$2 billion of U.S. exports and

\$6.2 billion of U.S. imports. There are also \$2.6 billion of exports and \$1.2 billion of imports carried by air. As a percent of total trade, truck and air transportation are relatively more important in southbound shipments, while rail and sea transportation claim a much higher percentage of northbound shipments. As explained above, U.S. imports (northbound shipments) can be expected to increase faster than U.S. exports (southbound shipments) during 1996.

*Table 2. 1994 estimated dollar value of U.S.-Mexico trade by mode of transportation*

	U.S. Exports to Mexico	% of Total Exports	U.S. Imports from Mexico	% of Total Imports
Truck	41,497,046,800	81.62	34,568,219,639	69.84
Rail	4,610,782,978	9.07	7,588,145,775	15.33
Sea	2,085,515,570	4.10	6,184,474,261	12.50
Air	2,646,919,726	5.21	1,151,961,021	2.33
Total	50,840,265,074	100.00	49,492,800,696	100.00

Source of basic data: McCray Research

## GROUND-TRANSPORTED NAFTA TRADE

Using the three data sets mentioned above, estimates of ground-transported North American trade were developed to provide a basis for the overall understanding of surface-transportation trade relationships. The value of total U.S. exports to and imports from Canada and Mexico as reported by the U.S. Department of Commerce was determined by taking the total exports and imports moving between the U.S. and Canada and between the U.S. and Mexico and subtracting the value shipped by air and sea, and subtracting noncontinental (Hawaii, Puerto Rico, and U.S. Virgin Islands) trade. The remaining value is total ground-transported trade. This primarily includes U.S. imports from and exports to Canada and Mexico transported via truck, rail, and pipeline. These values are shown in Table 3.

*Table 3. Benchmark ground-transported export and import values*

1994 Ground-Transported U.S. Exports to Canada	1994 Ground-Transported U.S. Imports from Canada	1994 Ground-Transported U.S. Exports to Mexico	1994 Ground-Transported U.S. Imports from Mexico	Total NAFTA Ground-Transported Trade
\$103,855,727,641	\$115,331,849,913	\$45,906,867,288	\$42,304,606,575	\$307,399,051,417

Tables for ground-transported trade were also presented in the earlier report, *Preliminary Study of the Impact of 1994 North American Free Trade Agreement (NAFTA) Ground-Transported Trade on U.S. States*, prepared by McCray Research. Although the earlier tables were adequate for the original work, they were based upon data that did not identify truck-

transported trade; consequently, these data could not be used to prepare the tables in this report. Therefore, the values shown in Table 3 differ slightly from the previously reported values for total ground-transported trade. These differences in value did not affect the cross-border trade values previously reported. However, the values reported for ground-transported trade by U.S. state of origin or destination were found to differ. To provide a consistent set of data, Attachment 1, *1994 Estimated Ground Transported U.S./Canada and U.S./Mexico Trade by State of Origin or Destination*, is included with this report. This table is more accurate than the table in the first report.

### ***Truck-Transported NAFTA Trade***

Estimates of truck-transported North American trade were developed to provide a specific understanding of the impact of North American Free Trade Agreement (NAFTA) truck-transported trade movement on the highway infrastructure of U.S. continental states. As mentioned previously, the major components of ground-transported trade are truck, rail, and pipeline. To derive an estimate of the value of truck-transported trade, the values of pipeline and rail shipments were subtracted from the estimates for total ground trade movement. The total estimated values of truck-transported exports to and imports from Canada and Mexico are shown in Table 4. These values were used as the benchmark values in all estimates of the value of trade by state of origin and destination and in the development of all cross-border trade estimates.

*Table 4. Estimated benchmark truck transported export and import values*

<b>1994 Truck-Transported U.S. Exports to Canada</b>	<b>1994 Truck-Transported U.S. Imports from Canada</b>	<b>1994 Truck-Transported U.S. Exports to Mexico</b>	<b>1994 Truck-Transported U.S. Imports from Mexico</b>	<b>Total NAFTA Truck-Transported Trade</b>
\$89,968,917,656	\$76,373,598,796	\$41,467,688,604	\$34,491,586,507	\$242,301,791,563

### ***U.S. State of Origin and Destination***

Attachment 2, *1994 Estimated Truck Transported U.S./Canada and U.S./Mexico Trade by State of Origin or Destination*, includes the values of exports and imports to and from Canada and Mexico transported by truck. The U.S. state of origin as used in this report is the state of the origin of shipment, that is, where the shipment began its export journey. Therefore, the value does not necessarily reflect the state in which the goods were manufactured. For example, if a wholesale distributor purchased goods from the manufacturer and then exported them, the state reported would be that of the distributor. Likewise, the U.S. state of destination reported is the state in which the goods ended their import journey (i.e., not necessarily that of the final consumer).

Michigan is the source or destination of \$43.8 billion of truck-transported NAFTA trade, or 18.07 percent of all U.S. truck-transported trade with Canada and Mexico. However, this trade is heavily dominated by trade with Canada. The second most active state in terms of NAFTA truck-

transported trade is Texas, with almost \$35 billion of imports and exports, or 14.43 percent of all truck-transported NAFTA trade. Texas' trade is heavily dominated by trade with Mexico. California and New York are also the origin or destination of a substantial amount of NAFTA truck-transported trade, with \$20.6 billion and \$18 billion of trade, respectively. Again, the location of the state greatly affects the make-up of its trade. California NAFTA trade is dominated by trade with Mexico, while New York NAFTA trade is dominated by trade with Canada.

### ***Cross-Border Trade by State***

In addition to the origin and destination of trade, the point at which NAFTA trade actually crosses the international border is also important in the analysis of the relationships of U.S. states with regard to this trade. Attachment 3, *1994 Estimated Truck Transported U.S./Canada and U.S./Mexico Trade Across Border States*, includes the U.S. state through which truck-transported NAFTA trade passed as it crossed the border to or from Canada or Mexico. The international boundaries through which U.S. trade flows are defined for this analysis as the boundaries of U.S. states along the U.S.-Mexico and U.S.-Canada border. There are ten states along the U.S.-Canada border which have land ports: Maine, Vermont, New York, Michigan, Minnesota, North Dakota, Montana, Idaho, Washington, and Alaska. There are four states along the U.S.-Mexico border: Texas, New Mexico, Arizona, and California.

Attachment 3 shows that 71.29 percent of truck-transported U.S. NAFTA trade is with Canada and 28.71 percent is with Mexico. With respect to specific crossing locations, the dominant border state on the U.S.-Canada border is Michigan, which is the location for processing 32.14 percent of all NAFTA truck transported trade and 46.81 percent of all U.S.-Canada truck-transported trade. The dominant state on the U.S.-Mexico border is Texas, with 23.59 percent of all NAFTA truck-transported trade, but 75.25 percent of all U.S.-Mexico truck transported trade. Therefore, truck-transported trade is much more highly concentrated along the U.S.-Mexico border than along the U.S.-Canada border.

## **CORRIDORS, POPULATION, AND MANUFACTURING CENTERS**

The flow of products between origins and destinations in the U.S. and Mexico through land ports on the U.S.-Mexico border defines U.S.-Mexico highway trade corridors in the U.S. Because most of the trade between the U.S. and Mexico moves by truck, and because the interstate highway system of the U.S. connects major population and manufacturing centers in the U.S. with major land ports along the U.S.-Mexico border, most of the dominant U.S.-Mexico highway trade corridors are located along U.S. interstate highways (IH). The pattern of flow creates the location of the highway corridor; the density of truck traffic, measured in numbers of trucks per year, determines the significance of the corridor. Although most interstate highways in the U.S. carry U.S.-Mexico trade traffic to some extent, not all of these highways can be considered trade corridors either in terms of the total volume of traffic or of the percent of highway truck traffic which is trade truck traffic.

Highway trade corridors are created as trade flows between major population and manufacturing centers through specific land ports on the U.S.-Mexico border. To develop an



understanding of the NAFTA trade transportation relationships that exist between the U.S. and Mexico, it is essential to recognize the location and concentration of population and manufacturing in Mexico and the U.S. In the U.S., these concentrations are located in the northeastern and southeastern regions and in Texas and California. More than three-fourths of the trade movements between Mexico and the U.S. are to or from Texas and the northeastern U.S. (i.e., the upper midwest and mid-Atlantic regions). In Mexico, the principal origin and destination for trade movements is the central portion of the country, which contains approximately two-thirds of the population and most of the manufacturing employment. The secondary origin and destination in Mexico is the maquiladora factories located along the Mexican side of the U.S.-Mexico border. Therefore, the primary trade flow between the U.S. and Mexico is from Texas and the northeastern U.S. into the heart of Mexico. This causes IH-35 between Laredo and Dallas to be the major U.S.-Mexico trade corridor in the U.S., with over 1 million trucks per year carrying products to and from Mexico.

As shown in Figure 2, trucks traveling on several highway segments carry U.S.-Mexico trade between the border and the major population and manufacturing centers in the U.S. These segments are divided into highways with over 1 million trucks carrying U.S.-Mexico trade per year; highways with 600,000 to 999,999 trucks per year; 300,000 to 599,999 trucks per year; 100,000 to 299,999 trucks per year; 70,000 to 99,999 trucks per year; and 40,000 to 69,999 trucks per year. Highways with fewer than 40,000 trucks per year (fewer than 110 trucks per day) were deemed not to be dominant highway trade corridors. The dominant U.S.-Mexico truck transportation corridor segment in the U.S. is along IH-35 from Laredo to San Antonio. This segment accounts for over 1 million trucks per year carrying U.S.-Mexico trade; these trucks also account for more than one-half of the truck traffic along this highway segment. The second most dominant highway segment is on IH-35 from San Antonio to Dallas. This highway segment also has over 1 million trucks per year carrying U.S.-Mexico trade, though these trucks account for only 20 percent of the total truck traffic. No other highway in the U.S. in 1994 had over 1 million U.S.-Mexico trade trucks per year.

The next most dominant U.S.-Mexico highway trade corridor segments, after IH-35 from Laredo to San Antonio and San Antonio to Dallas/Ft. Worth, are from Dallas to Memphis along IH-30 and IH-40, and from El Paso to the IH-10/IH-20 intersection along I-10. All other U.S.-Mexico highway trade corridors in the U.S. carry fewer than 600,000 trucks per year.

### **U.S.-MEXICO HIGHWAY TRADE CORRIDOR LOCATION**

Various factors can dictate the locations of new trade corridors or the expansion or improvement of existing corridors. These factors can include political influence from elected officials, communities, property owners, or other economic interests; the availability of capital to finance the expansion or improvements; the desire to stimulate economic development; or a thorough and arduous planning process. The rationale driving both the selection of the transportation mode to be used and the location of the corridor itself often ignores two significant factors: the origin and destination of the product flow, which is determined principally by the



concentration of population and manufacturing, and the “knowledge infrastructure” present, in the instance of U.S.-Mexico trade, at specific inland cities and ports along the U.S.-Mexico border.

Knowledge infrastructure is comprised of the sum of knowledge necessary to move products between their origins and destinations in the U.S. and Mexico. This knowledge infrastructure encompasses the translation of technical, commercial, and legal documents, a comprehensive understanding of U.S. and Mexican government regulations, an understanding of the manufacture and distribution of the specific products traded, location of markets, transportation and distribution efficiency, inventory and trade finance and insurance, classification of products, determination of tariffs under NAFTA, and customs procedures in the U.S. and Mexico. Knowledge infrastructure and physical infrastructure are both necessary to move products between the two countries.

The volume and value of trade transported over a given trade corridor will depend to a significant degree on the quality of knowledge and physical infrastructure along the corridor and at the land ports along the U.S.-Mexico border. The transportation of products will tend to shift by mode, corridor, or port based upon the knowledge infrastructure and the quality and cost (in both money and time) of transportation and distribution. Some important shifts will now be delayed as a result of the U.S. government’s postponing the opening of the U.S. border states to cross-border trucking on December 17, 1995, as required by NAFTA.

#### **LOCATION AND DENSITY OF TEXAS TRADE CORRIDORS**

The dominant highway trade corridors in the U.S. run through Texas, as shown earlier in Figure 2. Figure 3 presents a closer examination of U.S.-Mexico trade truck traffic on the Texas highway system, showing the Texas highway trade corridors and the associated trade truck density. As stated, IH-35 from Laredo to San Antonio and San Antonio to Dallas accounts for more than 1 million trucks per year carrying products between the U.S. and Mexico. The second most important highway segments in Texas, those with over 600,000 trade trucks per year, are IH-10 from El Paso to the intersection of IH-10 and IH-20, and IH-30 from Dallas east to the Texas border. Texas highways carrying between 300,000 and 599,999 trucks per year include IH-37 from San Antonio to Corpus Christi, and IH-10 from San Antonio to Houston. Texas highways carrying 100,000 to 299,999 trucks per year include U.S. 281 from McAllen to IH-37, U.S. 77 from Brownsville/Harlingen to Victoria, U.S. 59 from Houston to IH-37, IH-10 from the intersection of IH-10 and IH-20 to San Antonio, and IH-40 across the Texas Panhandle. U.S. 75 from Dallas to the northern Texas border is the only highway trade corridor in Texas with 70,000 to 99,999 trucks per year. Highway trade corridors with 40,000 to 69,999 trucks per year include U.S. 59 from Laredo to IH-37, and IH-20 from Dallas to the eastern border of Texas. Other trade highway corridors carry fewer than 40,000 trade trucks per year.

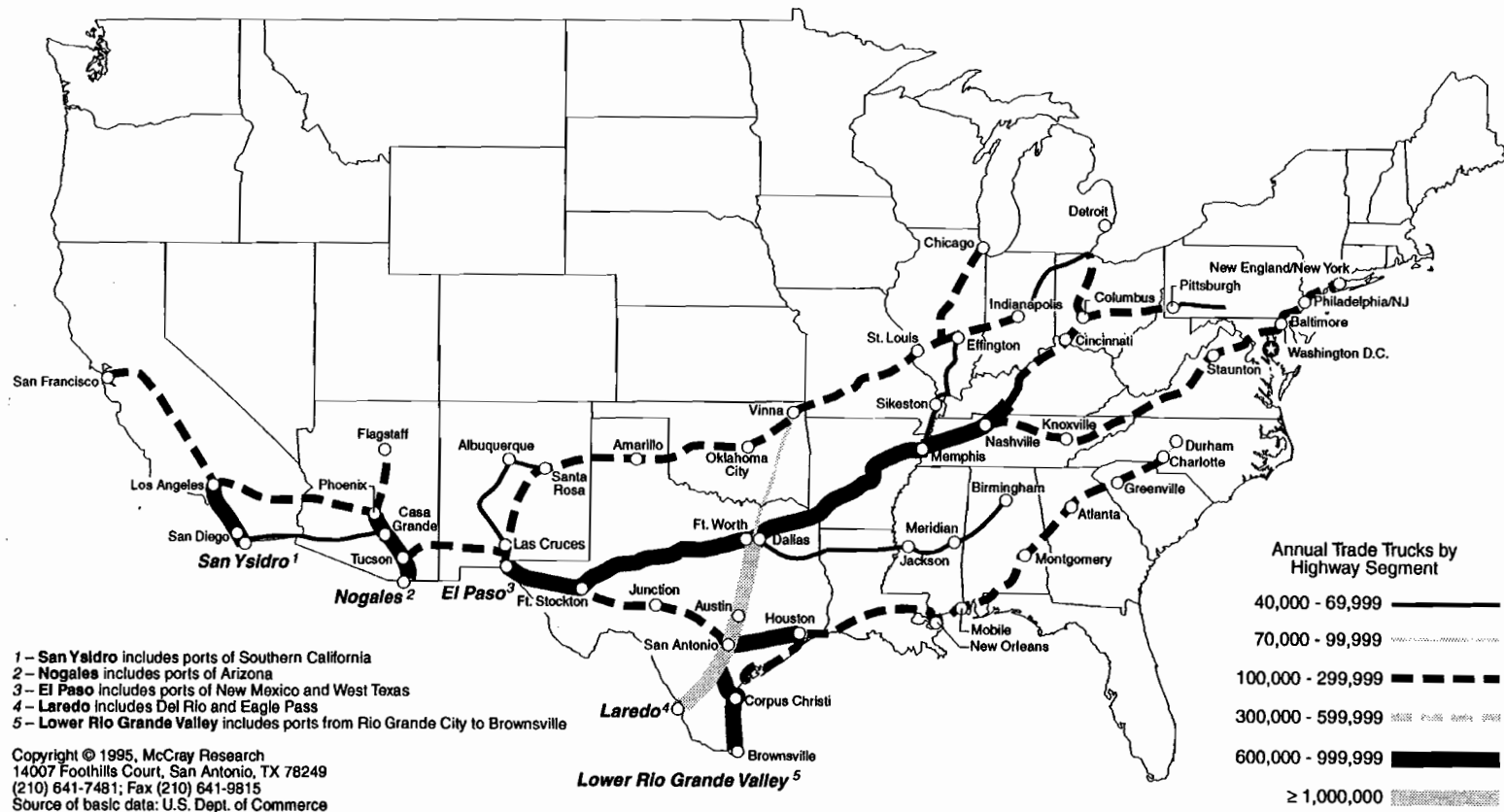
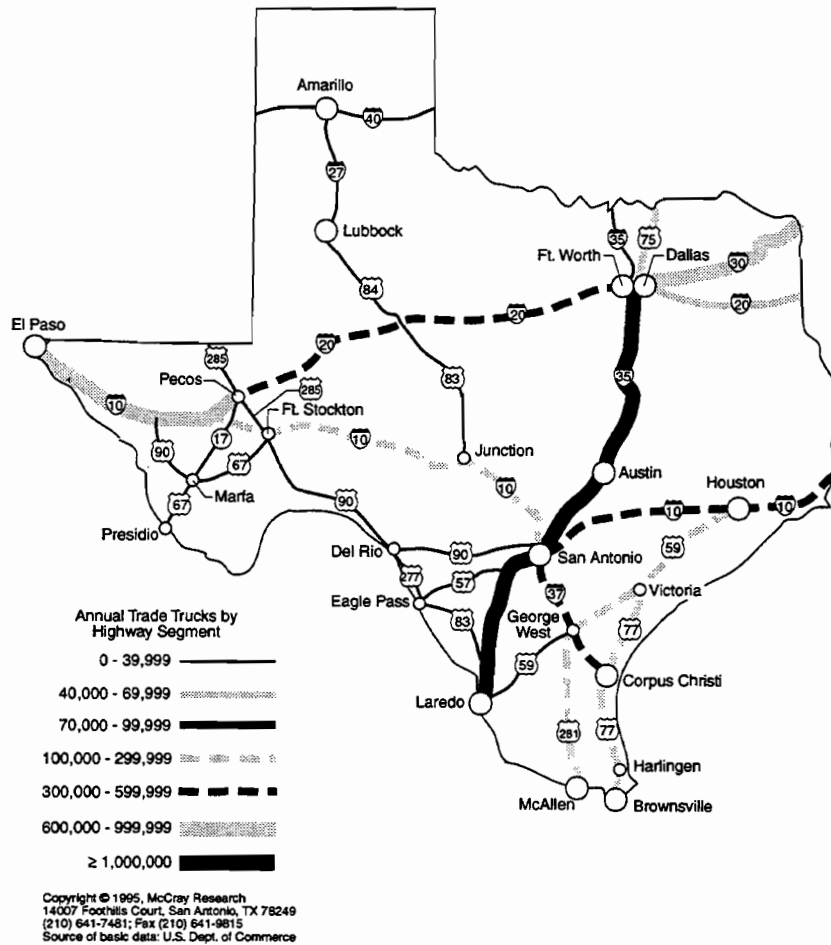


Figure 2. 1994 dominant U.S.-Mexico highway trade corridors



*Figure 3. 1994 estimated trucks carrying U.S.-Mexico trade on Texas highway corridors*

In addition to being some of the most heavily traveled highways for U.S.-Mexico trade, Texas highways also account for the highest density of trucks carrying this trade. Therefore, Texas highway policy makers should be concerned with the impact that these trucks will have on the state's highway system.

### **NAFTA AND GROWING TRUCK AND RAIL TRADE FLOW**

Continued implementation of NAFTA will increase the land-based flow of products between the U.S. and Mexico. The most important cross-border change should have occurred on December 17, 1995. At that time, cross-border freight pickups and deliveries should have been allowed within the border states of Mexico for U.S. trucking firms, and within the border states of the U.S. for Mexican trucking firms. The intent of this provision of NAFTA was to allow Mexican trucking companies the opportunity to pick up and deliver international cargo in cities in the U.S. border states of Texas, New Mexico, Arizona, and California in markets such as Los Angeles, Tucson, Dallas, Houston, and San Antonio. Also, U.S. trucking companies would have been

permitted to operate from anywhere in the U.S. and pick up and deliver international cargo in the Mexican states of Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas in markets such as Monterrey, Saltillo, Altamira/Tampico, and Cd. Chihuahua. At the same time, Mexico was to allow 49 percent Canadian and U.S. investment in Mexican trucking companies offering international cargo services. Since the U.S. refused to implement the transportation provisions of NAFTA that would open the border there has been no specific date set as to when the border will be opened.

Under NAFTA, January 1, 2000, was the date set to allow trucking companies of the U.S., Canada, and Mexico to have complete cross-border access in all three countries. It is now unclear whether the U.S. intends to honor this commitment. Also under NAFTA, January 1, 2001, was set as the date that 51 percent U.S. or Canadian ownership would be allowed in Mexican trucking firms doing international business and point-to-point distribution of international freight. Again, given the U.S. refusal to open the border on December 17, 1995, it is difficult to determine if the remaining transportation provisions of NAFTA will be implemented on time. Another provision of NAFTA to be implemented on January 1, 2004, calls for Mexico to permit 100 percent investment in international trucking companies by Canadian and U.S. firms. At no time will any NAFTA country be required to remove domestic cargo restrictions.

## **SUMMARY**

This report identified NAFTA truck-transported trade relationships for U.S. continental states using proprietary McCray Research trade flow information, careful analysis, and trade data sets obtained from the U.S. Department of Commerce and the U.S. Department of Transportation. Estimates of the ground-transported trade with an origin and destination in a U.S. continental state are shown in Attachment 1. Estimates of the origin and destination of truck transported trade are shown in Attachment 2. Estimates of the cross-border trade by state are shown in Attachment 3.

With regard to the U.S. state of origin and destination of NAFTA truck-transported trade, Michigan, Texas, California, and New York lead the U.S. with 18.05 percent, 14.42 percent, 8.49 percent, and 7.44 percent of total truck-transported NAFTA trade, respectively. While trade with Canada dominated the trade flow of Michigan and New York, trade with Mexico dominated the trade flow of Texas and California.

Michigan and New York are the point of border crossing for over one-half of all U.S. NAFTA truck-transported trade and account for almost 80 percent of all U.S.-Canada truck-transported trade. Along the Mexican border, Texas accounts for the point of border crossing for 23.59 percent of all U.S. NAFTA truck-transported trade and 75.25 percent of all U.S.-Mexico truck transported trade.

As explained above, the Transborder data set used in this work has been available for less than three years. The quality and reliability of this data set can be expected to improve over time as collection criteria become more clear in the collecting agency. Because of the difficulty in working with the 1994 data used in this report, it is highly recommended that additional analysis of the NAFTA-related truck trade flow be conducted with a set of calendar year 1995 data, which should become available in May of 1996.

Additional work should also be accomplished to include more analysis of the rate of growth of trade movements to and from U.S. states and across the boundaries of the U.S. border. Additional analyses should also be undertaken to determine the impact of NAFTA truck-transported trade on specific highway corridors.

The growth of trade between the U.S. and Mexico has resulted in the development of well-defined truck highway corridors carrying products between ports along the U.S.-Mexico border and major concentrations of population and manufacturing in the U.S. This trade flows primarily from the northeastern U.S. and Texas to the border cities of Laredo and El Paso. The dominant truck transportation corridors, with more than 1 million trucks per year carrying U.S.-Mexico trade, are from Laredo to San Antonio and from San Antonio to Dallas/Ft. Worth. The next most dominant highway trade corridors, with 600,000 to 999,999 trucks per year, are from Dallas/Ft. Worth to Memphis, Tennessee, and from El Paso to the intersection of I-10 and I-20 near Ft. Stockton, Texas. The location, truck density, and investment needed in these corridors, which transport most of the trade between the U.S. and Mexico, will continue to require accurate analyses and careful policy decisions from the Texas and U.S. governments.

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**ATTACHMENT 1**

**1994 ESTIMATED GROUND-TRANSPORTED U.S.-CANADA AND U.S.-MEXICO  
TRADE BY STATE OF ORIGIN OR DESTINATION**



**1994 Estimated Ground Transported U.S./Canada and U.S./Mexico Trade  
by State of Origin or Destination  
(Estimated Dollar Value)**

State	Exports to Mexico	Exports to Canada	Imports from Mexico	Imports from Canada	Total	Percent of Total
MI	3,127,355,170	19,498,250,777	6,636,545,524	33,944,538,728	63,206,690,200	20.56%
TX	20,675,448,106	4,451,881,261	12,850,547,765	2,803,027,242	40,780,904,373	13.27%
CA	6,527,604,139	5,143,530,919	7,197,950,970	4,702,432,172	23,571,518,200	7.67%
NY	995,984,527	7,873,127,828	935,133,453	12,795,217,850	22,599,463,658	7.35%
OH	1,000,250,598	8,743,556,028	1,774,409,639	5,502,489,013	17,020,705,278	5.54%
IL	1,555,840,377	6,812,876,193	932,941,102	6,786,900,164	16,088,557,836	5.23%
PA	803,873,095	3,958,483,069	327,191,256	3,808,269,825	8,897,817,245	2.89%
IN	696,565,215	4,333,654,448	1,525,834,342	1,944,017,131	8,500,071,136	2.77%
WA	197,148,198	2,191,907,100	62,108,033	4,409,210,621	6,860,373,952	2.23%
MA	325,306,287	2,768,307,120	231,363,435	3,370,813,632	6,695,790,474	2.18%
NJ	641,535,756	2,633,952,793	625,060,263	2,597,595,350	6,498,144,163	2.11%
WI	407,488,003	3,275,302,529	160,237,035	2,653,006,944	6,496,034,511	2.11%
MN	216,802,467	2,286,236,898	126,124,000	3,748,847,727	6,378,011,091	2.07%
TN	644,256,112	2,285,055,167	1,344,789,594	1,970,965,037	6,245,065,910	2.03%
NC	632,592,761	2,895,949,798	979,487,398	1,574,736,899	6,082,766,855	1.98%
AZ	2,210,104,117	350,089,474	2,474,243,476	305,880,895	5,340,317,962	1.74%
VT	17,369,508	2,137,148,210	12,672,463	2,673,897,155	4,841,087,337	1.57%
KY	254,340,493	2,075,358,270	536,568,439	1,550,223,725	4,416,490,927	1.44%
GA	495,334,822	1,595,162,152	413,665,644	1,528,324,264	4,032,486,882	1.31%
MO	546,328,862	1,522,626,154	213,168,160	1,191,773,287	3,473,896,463	1.13%
FL	495,080,023	1,152,787,583	194,298,704	1,146,908,717	2,989,075,027	0.97%
CT	364,369,906	1,291,270,209	196,531,993	1,038,363,847	2,890,535,955	0.94%
OR	126,018,155	1,302,982,728	16,522,379	1,261,477,801	2,707,001,063	0.88%
SC	261,304,300	1,210,843,466	508,081,130	646,042,921	2,626,271,817	0.85%
VA	293,824,303	1,106,129,723	177,718,047	1,039,772,187	2,617,444,261	0.85%
IA	191,123,554	1,351,371,183	27,769,674	929,938,857	2,500,203,268	0.81%
AL	233,987,880	867,942,420	406,279,183	616,214,917	2,124,424,401	0.69%
MD	82,703,909	1,163,059,251	25,941,635	783,223,658	2,054,928,453	0.67%
DE	199,431,054	846,444,361	109,814,869	431,646,312	1,587,336,596	0.52%
KS	294,082,449	761,221,741	43,175,159	476,875,507	1,575,354,855	0.51%
CO	257,621,980	598,563,738	51,730,722	661,908,448	1,569,824,888	0.51%
OK	205,300,001	642,324,497	416,719,183	248,095,703	1,512,439,384	0.49%
ME	28,031,788	484,279,700	25,355,645	968,516,682	1,506,183,814	0.49%
ND	18,092,562	315,015,971	1,677,478	916,967,363	1,251,753,374	0.41%
AR	128,003,862	558,416,928	80,350,718	407,816,195	1,174,587,703	0.38%
LA	151,631,701	508,804,047	169,701,283	296,372,361	1,126,509,392	0.37%
NE	174,138,065	427,990,235	40,792,804	327,082,888	970,003,992	0.32%
MS	106,474,110	369,639,601	188,159,355	259,244,832	923,517,897	0.30%
NH	44,080,114	337,341,825	22,518,386	465,442,044	869,382,369	0.28%
UT	54,407,119	344,450,526	20,138,325	428,120,688	847,116,658	0.28%
MT	13,136,377	161,480,847	516,624	652,244,710	827,378,559	0.27%
WV	21,865,049	324,066,849	30,881,679	328,463,225	705,276,802	0.23%
RI	27,372,806	324,306,944	24,384,831	296,650,118	672,714,699	0.22%
ID	41,313,228	206,382,754	26,326,264	315,928,399	589,950,645	0.19%
NV	12,602,148	118,099,256	17,718,453	174,789,451	323,209,309	0.11%
NM	92,116,346	35,551,516	112,211,537	54,359,140	294,238,539	0.10%
SD	6,114,437	102,298,816	4,288,895	169,117,433	281,819,580	0.09%
AK	4,280,654	54,413,545	4,902,096	73,665,599	137,261,895	0.04%
WY	6,830,795	55,791,190	57,532	54,432,253	117,111,769	0.04%
<b>Total</b>	<b>45,906,867,288</b>	<b>103,855,727,641</b>	<b>42,304,606,575</b>	<b>115,331,849,913</b>	<b>307,399,051,417</b>	<b>100.00%</b>





**ATTACHMENT 2**

**1994 ESTIMATED TRUCK-TRANSPORTED U.S.-CANADA AND U.S.-MEXICO  
TRADE BY STATE OF ORIGIN OR DESTINATION**



**1994 Estimated Truck Transported U.S./Canada and U.S./Mexico Trade  
by State of Origin or Destination  
(Estimated Dollar Value)**

State	Exports to Mexico	Exports to Canada	Imports from Mexico	Imports from Canada	Total	Percent of Total
MI	2,514,389,711	16,709,762,853	2,463,069,359	22,093,379,428	43,780,601,351	18.07%
TX	18,838,259,903	3,495,837,355	10,943,096,180	1,678,873,229	34,956,066,668	14.43%
CA	6,418,455,007	4,779,496,720	6,942,494,967	2,451,060,753	20,591,507,448	8.50%
NY	840,155,308	7,355,408,953	826,837,550	9,021,113,923	18,043,515,734	7.45%
OH	930,275,998	7,513,626,097	1,760,559,734	4,242,461,372	14,446,923,201	5.96%
IL	1,380,148,588	5,447,050,079	838,326,467	3,403,926,893	11,069,452,026	4.57%
IN	674,952,266	3,947,098,135	1,503,169,596	1,529,103,134	7,654,323,131	3.16%
PA	723,366,357	3,719,628,377	307,481,374	2,712,950,942	7,463,427,051	3.08%
MA	322,261,386	2,741,206,451	226,677,244	2,978,963,704	6,269,108,784	2.59%
NJ	628,343,105	2,276,823,318	611,869,998	2,140,593,020	5,657,629,441	2.33%
NC	607,657,686	2,834,987,050	978,806,438	1,206,848,349	5,628,299,522	2.32%
AZ	2,184,943,231	336,420,859	2,419,505,284	209,735,564	5,150,604,938	2.13%
WA	168,313,218	2,105,484,143	60,762,174	2,411,225,892	4,745,785,426	1.96%
VT	17,352,298	2,131,279,571	12,672,463	2,487,640,287	4,648,944,619	1.92%
WI	384,625,553	2,354,411,959	159,114,015	1,387,915,041	4,286,066,568	1.77%
TN	471,822,927	1,779,099,753	982,473,389	1,044,982,858	4,278,378,928	1.77%
KY	223,405,149	1,509,829,227	514,599,800	1,068,718,636	3,316,552,812	1.37%
MN	189,704,450	1,811,082,373	125,621,577	1,170,416,710	3,296,825,110	1.36%
GA	407,008,524	1,334,056,950	332,973,998	1,129,628,911	3,203,668,382	1.32%
MO	381,852,998	1,269,508,475	189,063,137	811,166,313	2,651,590,923	1.09%
FL	434,290,908	1,079,902,253	176,736,809	798,453,109	2,489,383,078	1.03%
CT	325,179,403	1,202,292,565	189,022,178	758,633,371	2,475,127,517	1.02%
SC	240,342,567	1,100,122,854	507,648,610	559,942,884	2,408,056,915	0.99%
OR	123,509,510	1,231,990,442	12,888,366	931,020,066	2,299,408,384	0.95%
VA	221,258,934	1,016,343,140	171,168,622	796,978,671	2,205,749,367	0.91%
IA	136,337,486	1,091,610,112	27,769,674	415,152,294	1,670,869,566	0.69%
AL	199,342,759	759,353,795	378,074,403	309,123,385	1,645,894,341	0.68%
MD	76,038,375	841,041,813	25,941,635	612,279,192	1,555,301,015	0.64%
CO	243,028,743	511,889,367	48,963,201	483,405,138	1,287,286,450	0.53%
DE	194,672,560	658,912,679	32,007,507	334,474,384	1,220,067,130	0.50%
ME	27,543,657	456,851,439	23,821,653	654,657,768	1,162,874,517	0.48%
KS	97,204,607	505,232,796	43,175,159	394,476,534	1,040,089,096	0.43%
ND	3,068,104	247,720,523	1,483,844	775,957,289	1,028,229,760	0.42%
OK	179,784,914	545,825,598	69,948,799	205,063,934	1,000,623,245	0.41%
AR	100,462,748	485,645,330	72,626,415	253,300,963	912,035,456	0.38%
MS	83,874,889	339,438,498	187,477,802	191,958,934	802,750,124	0.33%
NH	44,066,072	332,861,607	22,518,386	400,456,013	799,902,078	0.33%
NE	88,203,694	345,857,162	40,622,893	261,977,905	736,661,654	0.30%
LA	114,690,309	337,486,293	24,506,069	217,161,801	693,844,471	0.29%
UT	52,096,623	252,483,015	20,136,805	312,377,378	637,093,821	0.26%
RI	27,249,037	321,584,984	24,275,182	260,054,440	633,163,643	0.26%
WV	19,691,806	240,411,203	30,076,704	269,026,638	559,206,351	0.23%
ID	27,543,754	183,567,646	22,659,333	238,324,305	472,095,039	0.19%
MT	6,158,503	116,576,618	465,210	348,623,313	471,823,644	0.19%
NV	12,321,910	114,738,331	17,574,776	129,783,023	274,418,040	0.11%
NM	70,221,896	32,004,270	111,608,425	40,483,318	254,317,909	0.10%
SD	5,178,606	74,869,462	4,288,895	130,162,699	214,499,661	0.09%
AK	3,477,266	48,586,085	4,866,877	68,494,328	125,424,556	0.05%
WY	3,555,301	41,619,079	57,532	41,090,761	86,322,673	0.04%
<b>Total</b>	<b>41,467,688,604</b>	<b>89,968,917,656</b>	<b>34,491,586,507</b>	<b>76,373,598,796</b>	<b>242,301,791,563</b>	<b>100.00%</b>



**ATTACHMENT 3**

**1994 ESTIMATED TRUCK-TRANSPORTED U.S.-CANADA AND U.S.-MEXICO  
TRADE ACROSS BORDER STATES**



1994 Estimated Truck Transported U.S./Canada and U.S./Mexico Trade  
 Across Border States  
 (Estimated Dollar Value)

**U.S. - Canada Border**

States	U.S. Exports to Canada	U.S. Imports from Canada	Total	Percent of Canada	Percent of North America
MI	42,972,732,481	34,899,478,284	77,872,210,765	46.81%	32.14%
NY	28,226,063,719	25,565,329,785	53,791,393,504	32.34%	22.20%
WA	6,156,592,182	3,685,179,996	9,841,772,177	5.92%	4.06%
ND	4,232,339,925	2,925,141,262	7,157,481,187	4.30%	2.95%
VT	3,961,322,254	4,660,725,730	8,622,047,984	5.18%	3.56%
MT	2,323,200,804	1,487,983,116	3,811,183,919	2.29%	1.57%
MN	658,820,850	682,882,238	1,341,703,088	0.81%	0.55%
ME	1,045,530,200	1,908,647,084	2,954,177,284	1.78%	1.22%
ID	343,955,135	541,015,625	884,970,760	0.53%	0.37%
AK	48,360,108	17,215,677	65,575,784	0.04%	0.03%
<b>Total</b>	<b>89,968,917,656</b>	<b>76,373,598,796</b>	<b>166,342,516,453</b>	<b>100.00%</b>	<b>68.65%</b>

**U.S. - Mexico Border**

States	U.S. Exports to Mexico	U.S. Imports from Mexico	Total	Percent of Mexico	Percent of North America
NM	8,083,067	17,525,867	25,608,933	0.03%	0.01%
CA	5,471,155,234	6,453,907,955	11,925,063,189	15.70%	4.92%
TX	32,561,377,645	24,596,922,682	57,158,300,327	75.25%	23.59%
AZ	3,427,072,658	3,423,230,003	6,850,302,661	9.02%	2.83%
<b>Total</b>	<b>41,467,688,604</b>	<b>34,491,586,507</b>	<b>75,959,275,110</b>	<b>100.00%</b>	<b>31.35%</b>