Assessing Border Costs in Transportation:

Impact of Trucking Regulations and Land Port Congestion on NAFTA Trade

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1 Research Question

Estimating border costs and understanding their nature are of paramount importance for economists and policy makers. Although recent advances in the literature investigate empirically and quantitatively how transport costs impact trade flows and welfare, most border costs remain a black box. The objective of our project is to unpack a transportation related component of borders costs in the NAFTA/USMCA area: international trucking regulations and the efficiency of border land ports.

We plan to use a workhorse trade model with an explicit transportation sector that takes into account the presence of both border congestion and international trucking regulations. Paying particular attention to the US-Mexico border—the most economically active land border in the world—the quantified model will help gauge how current policies distort transportation markets and reduce potential gains from trade. In our context, two institutional characteristics influence border costs. First, the trucking sector is highly regulated by the USMCA, granting significant protectionism to American truck drivers. Current policies make it almost impossible for drivers to deliver goods outside their country of origin. The second characteristic is that land ports at the border face sizable congestion. As a result, increased travel times due to transshipments at the border, port congestion and segmented labor markets for truck drivers drive up transportation costs.

Our project has relevance for three issues regarding U.S. transportation policy: (i) how international trucking regulations impact the use of the Interstate Highway System (ii) how the efficiency of border ports can influence truck traffic in particular highway segments (iii) the optimal investment in border ports, which requires coordination of transportation and security policymakers in the U.S. and Mexico.

Last, this project is relevant to four strands of the international trade literature. First, the literature on border costs (Gorodnichenko and Tesar, 2009; Engel and Rogers, 1996; McCallum, 1995). We aim to unpack the drivers of these costs and quantify their macroeconomic impacts. Second, the literature on the effects of non-tariff barriers (Rodrik, 2018). Measuring the general equilibrium impacts of non-tariff barriers is challenging since it requires detailed institutional information (Deardoff and Stern, 1997). Fortunately, our context allows us to disentangle the mechanisms of their welfare impacts i.e., border congestion and international trucking regulations. Third, we add to the recent literature on global supply chains and the welfare gains of NAFTA or USMCA (Caliendo and Parro, 2015; Kehoe and Kehoe, 1994; Krueger, 1997; Romalis, 2007). Our project will highlight the importance of North America supply chains given the increased near-shoring of trade from China to Mexico. Finally, we will contribute to the literature on trade and transportation. The focus of this literature has been to use internal trade and domestic commuting flows to understand the welfare impacts of road investments (Allen and Arkolakis, 2022). We will focus on the importance of the capacity at border crossings and freight regulations on the spatial patterns of truck traffic and internal trade flows.

2 Relevance of Potential Findings for the DOT

Our project will inform the DOT on five policy issues. First, we will show how the nearshoring boom in Mexico will impact the use of specific highway segments in the U.S., and thus the levels of depreciation in these road arteries. Second, we can inform the DOT on how the congestion in the US-Mexico border ports can shift demand for roads across the Interstate Highway System. For example, if the border port Juarez-El Paso would increase its efficiency, more firms would use it to ship goods from Mexico to the U.S., and more truck drivers would go through Interstate 25, which would require higher maintenance by the DOT. The

same shock would reduce the use of the Laredo–Nuevo Laredo border port, which would decrease the use of Interstate 35, thus requiring less maintenance funds. This information can inform the DOT's maintenance budget.

Third, our project highlights the cross-border coordination in investment between the DOT and Mexico's Ministry of Communications and Transportation. The current quality of Mexican roads impacts the existing congestion in US-Mexico border ports, which influences the demand for specific highways of the Interstate Highway System. Our project highlights the fact that the cross-border coordination of road infrastructure projects is key for the DOT. Fourth, our project would highlight the general equilibrium effects of border port investments. These investments are typically coordinated by the General Services Administration and they involve the coordination of several federal agencies, including the DOT.

Fifth, we ultimately aim to construct a matrix of region-to-region commodity flows within the USMCA, that is, between American and Mexican states, and Canadian provinces. The construction of this dataset will help the transportation agencies in these three nations to plan their long-term investments. Moreover, this dataset can be useful for other international agencies that help international cooperation on infrastructure such as the North American Development Bank, the World Bank, and the Inter-American Development Bank.

3 Use of the Grant

One of our primary goals is to impute bilateral commodity flows between American and Mexican states, and make it publicly available to researchers and practitioners. Such data does not exist as of today. To do so, we will use novel data sources from Mexico and follow the methodology of Herrera-Dappe et al (2019), henceforth referred to as the freight origin-destination synthesis (FODS). The main inputs for this imputation include traffic along the Mexican primary highway system and across border land ports. As we explain in detail below, this effort requires digitization of Mexican government documents and collecting traffic data in key highways in U.S. border states (CA, NM, AZ, TX) from their local Departments of Transportation. We will also use standard data from the customs and economic censuses. We now give a brief description of our planned work.

3.1 U.S. Data

- **U.S. Census' Commodity Flow Survey:** We will use the restricted version of the CFS linked with the Census of Manufacturers. This linked dataset will allow us to estimate a linear model on the determinants of freight supply and demand for North American regions at the 6-digit NAICS level.
- **Border crossing data:** The Bureau of Transportation Statistics reports the U.S.-bound truck flows per year, for each port of entry along the U.S.-Mexico border. Unfortunately, these data do not contain Mexico-bound flows.
- **Data on traffic cameras near the border points of entry:** The local Departments of Transportation of four states (California, Arizona, New Mexico, and Texas) have traffic cameras on segments of the Interstate Highway System that are located less than half a mile away from each US-Mexico border port of entry. These data allow us to estimate Mexico-bound yearly traffic truck flows, which carry international trade shipments between both nations.
- **U.S. Census' international trade data:** The US Trade Online website provides publicly available data on the value of state-level exports and import by trade partner at the 6-digit HS-level. Separately, it also reports country- and HS-6-level trade flows by port of exit and entry, with additional product (HS10) detail at the level of customs districts.[1] For example, we know the value of monthly exports from the state of Oregon to Mexico, and monthly value of total exports via the border port located in Otay Mesa, CA.

3.2 Mexican data

- **Economic Census:** Mexico's National Institute of Statistics (INEGI) provides detailed data for each state at the 6-digit NAICS industry level on output, intermediate goods purchases, value-added, em-

[1] Unfortunately, the dataset contains information on the weight for maritime and air modes, but not for land.

ployment, revenue, and expenditures. We will use this data as an input for the FODS to impute commodity flows between Mexican states (Mexican domestic trade) and between American and Mexican states.

- **Truck traffic data:** We obtained scanned reports on truck traffic data from Mexico's Ministry of Communications and Transportation. The data contains information on 300 permanent stations located along the primary highway system. We plan to digitize the data for these reports with the help of research assistants. The digitized data will allow us to estimate traffic between the main highway arteries connecting Mexican states. We can use these data as inputs for the FODS. We display the location of all the stations in the left panel of Figure 1.
- **Origin-destinations survey of truck flows and cargo:** We obtained data from an origin-destination (OD) survey for 2017 from the Mexican Institute of Transportation, a transportation research center (*Instituto Mexicano de Transporte* or IMT). The survey contains information on total truck flows between Mexican cities and total tonnage. The IMT used thirteen stations to collect data (right panel of Figure 1). We plan to use this OD survey to verify the robustness of the results of predicted commodity flows between American and Mexican states.

3.3 Methodology to impute commodity flows across North American regions

The Freight Demand Generation model used by Herrera-Dappe et al (2019) allows researchers to impute a matrix of commodity flows based on observed traffic data across points of the highway system that connect regions. The authors use traffic data and different surveys to generate inter-regional commodity flows within Bangladesh, a country with data limitations regarding internal trade. In our case, we will construct a matrix of commodity flows between American and Mexican states. In doing so, we will account for existing data on commodity flows such as the Commodity Flow Survey and U.S. customs data. While the latter contains information on Mexico's exports to U.S. states, it is agnostic on the Mexican state origin. There are two sets of flows that we must impute. First, those within Mexico. Second, completing all bilateral flows between cross-border regions. We plan to proceed in the following manner.

The first step is to obtain the determinants of freight demand and freight supply for North American regions based on observed economic characteristics. Using linked observations of the Census of Manufacturers and the Commodity Flow Survey, we will use a linear model in which the dependent variable is the shipment weight and values sent or received by every establishment, and the independent variables are employment, value added per worker, and intermediate expenditures. We will estimate this regression at the 6-digit NAICS industry level. We then use these coefficients to fit the Mexican state-level 6-digit NAICS industry employment, intermediate consumption, and value data to predict freight demand and supply in each Mexican state/industry.[2]

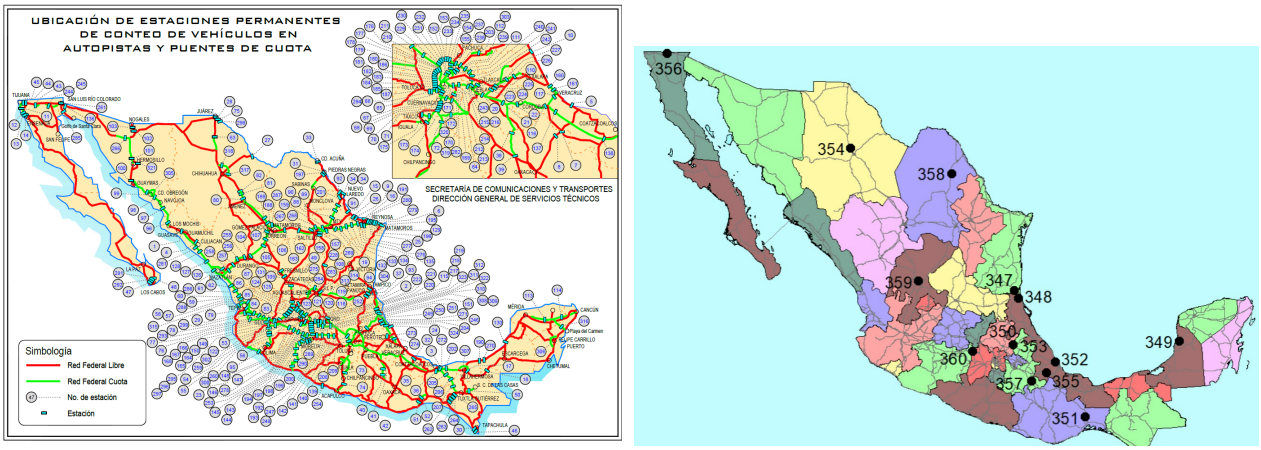
The second step consists of using a transportation engineering model with economic features i.e. gravity equation and trade costs, to predict the commodity flows by industry based on (i) regional freight demand (ii) regional freight supply (iii) truck traffic along the highways and across the U.S.-Mexico border ports. The model considers that the sectoral commodity flows follow a standard gravity equation, and that most of the commodity flows between regions follow the shortest path along highways. This methodology also considers that part of the truck traffic observed along highways and the US-Mexico border contains empty trucks. According to the transportation literature, the absence of this assumption leads to large prediction errors for imputed region–region commodity flows (Holguin-Veras and Thorson, 2003).

Imputations based on the FODS depend on two key parameters. First, the parameter that defines the relationship between trade costs and travel times. We will obtain parameter estimates at the 6-digit NAICS industry level. The second parameter is the probability that we observe empty trucks when we consider the traffic flows of trucks between two regions. This parameter is similar across industries. We use as input the information on traffic from every highway link and US-Mexico border port of entry. The former come from Mexico's Ministry of Communications and Transportation printed traffic reports and we will obtain the latter from traffic cameras in American cities along the southern border.

The estimation algorithm finds the parameter estimates that minimize the difference between predicted and observed traffic flows along highway links and U.S.-Mexico border ports. Once we obtain our parameter

[2]Implicitly, we assume that the determinants of freight demand and freight supply by region are similar for Mexican and American regions. We justify this assumption with the economic integration of the manufacturing sector of both nations.

Figure 1: **Traffic measurement stations in Mexico's Primary Highway System**



Source: Left figure is from official documents of the Mexican Ministry of Communications and Transportation and shows all traffic stations along the primary highway system. Right figure represents the traffic stations used to construct the OD survey of the Mexican Institute of Transportation.

estimates, we use the transportation model to predict the commodity flows between Mexican states and the flows between US-Mexican state pairs. Finally, we can use the OD cargo survey from the Mexican Institute of Transportation, which tracks cargo flows between Mexican cities measured by weight, to analyze whether our commodity flow shares Mexican state – Mexican state resemble the implied shares from the OD cargo survey.

3.4 Model

With imputed US-Mexican inter-regional bilateral trade flows at hand, we will build and calibrate a workhorse trade model in which transportation regulations shape trade flows and freight traffic. In our model, firms use local labor and tradable intermediate inputs for production. The trade cost for intermediate inputs is influenced by three factors: (i) the travel times between the origin and the destination of the intermediate goods, (ii) the trucking cost, which depends on the salary of the truck drivers that move these inputs, (iii) the waiting times in the US-Mexico border, and (iv) the elasticity of substitution between border ports, which influences the optimal Mexican and American highway routes and the travel time of truck drivers. The modeling of endogenous transport costs will follow Coşar et al. (2024) who posit an explicit production function for transportation services using labor, capital, and intermediate inputs.

In the baseline, we take the existing stringent transportation regulations that prevent Mexican truck drivers from delivering goods to the final destination in the US. Hence, those shipments incur not only transshipment costs at the border but also higher American driver wages. These differences are substantial: the average wage of a Mexican and American truck driver is $9,600 and $49,920, respectively.[3]

Our main counterfactual consists of liberalizing the trucking sector by allowing Mexican drivers to deliver goods to final destinations in the US. Further liberalization scenarios entail the possibility of carrying backhaul cargo to Mexico, and further competing for internal shipments within the US. In all these counterfactuals, transportation costs would fall not only in the cross-border trade, but also within the US. In another counterfactual, we will consider the effects of major increases in border inspections, which would increase travel times for inputs traded in the supply chain. In all cases, our objective is to use a quantified trade model to gauge the impact of changes in border costs on jobs and production in the USMCA area.

Disclosure statement. *Luis Baldomero-Quintana and Kerem Coşar declare that they have no connections and no financial interests related to the transportation industry. They also declare no conflicts of interest that relate to the research described in this project.*

[3]For Mexican wages, we obtained the highest wage from the official website Data Mexico created by the Ministry of Economy (https://www.economia.gob.mx/datamexico). We chose the annual wage for drivers in the border state of Tamaulipas. For American wages, we use the median pay in 2022, provided by the official website of the Bureau of Labor Statistics.

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