Measuring Border Crossing Costs and their Impact on Trade Flows: The United States-Mexican Trucking Case

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Alan K. Fox*, U.S. International Trade Commission, Washington, DC

Joseph F. Francois, Erasmus University, Rotterdam

Pilar Londoño-Kent†, Erasmus University, Rotterdam

Abstract

This article presents the economic implications of the costs and times of crossing the border between the United States and Mexico. We measure the microeconomic impact of the inefficiencies of crossing the U.S.-Mexican border on shippers. We identify and explain the institutional factors and vested interests that permit cross-border inefficiencies to appear and endure and estimate the costs of these inefficiencies associated with cross-border movements between the U.S. and Mexico. Inefficiencies here are defined as money paid by shippers for charges for non-essential border-crossing services. These inefficiencies not only cost exporters and importers time and money—they also cause welfare losses to the entire economy because of the distortions they introduce to consumption and sourcing decisions. In order to measure both the primary and secondary impacts of these nontariff barriers, we use the General Trade Analysis Project-GTAP- model to simulate the removal of iceberg trade costs equal in magnitude to the measured nontariff barriers at the U.S.-Mexican border.

The measures of inefficiency at the U.S.-Mexican border come from detailed border surveys and data analysis performed by Haralambides and Londoño-Kent ("Impediments to Free Trade: The Case of Trucking and NAFTA in the U.S.-Mexican Border", mimeo, 2002). These measures of distortion are then used to calibrate an iceberg tariff within the GTAP model. We aggregate the GTAP version 5 database to 5 regions (U.S., Mexico, Canada, EU, Rest of World) and to 11 sectors. The removal of iceberg tariffs is simulated by shocking the values of the variable AMS, augmenting technical change for the relevant sectors and trade flows. We estimate that removal of such barriers would benefit the Mexican economy by $1.8 billion per year, while the U.S. economy would see a welfare increase of about $1.4 billion per year. Trade flows between Mexico and the United States would likewise increase, with southbound trade expanding by about $6 billion and northbound trade growing by about $1 billion per year.

* The opinions and results stated in this paper are those of the authors. They do not necessarily represent the views of the institutions with which they are affiliated.

† Corresponding author. pilarkent@aol.com.

Introduction

Much research has been done to assess the effect of trade barriers on patterns of international trade. The models developed for this purpose permit the formal presentation of how formal trade barriers might impact trade volumes. On the other hand, relatively little study has been conducted on how informal trade barriers impact trade volumes.

As Hummels (2001) asserts: "nontariff barriers of various sorts and structural impediments are less obvious and perhaps more interesting, but also much more difficult to directly measure. As a consequence, researchers rely primarily on indirect methods: positing a model of bilateral trade flows and correlating flows with proxy variables meant to represent trade barriers."

The objective of this article is the formal presentation of the implications of border crossing related trade barriers, or non-tariff barriers, in the trade between the United States and Mexico. We measure the microeconomic impact of the inefficiencies of border crossing in the U.S.- Mexican border on shippers and the institutional factors and vested interests that permit the inefficiencies to appear and last for extended period of time. Inefficiencies here are defined as money paid by shippers for charges for non-essential border crossing services and the times involved in each step of the border crossing operation.

Description of Border Crossing Logistics

Haralambides and Londoño-Kent (2002) researched the movements, the times, and costs of each procedure in the transport of manufactured products across the Laredo to Nuevo Laredo border, the largest crossing point between the United States and Mexico, applied to a hypothetical example of a shipment from Chicago (United States) to Monterrey (Mexico). They identified the steps in the transportation system and measured their corresponding times and costs. These include: (1) trucking from Chicago to Laredo, Texas; (2) handling costs and associated times of Mexican broker inspections for pre-clearance and storage; (3) costs of loading and unloading; (4) drayage costs and times of border crossing transport from Laredo, Texas to Nuevo Laredo, Mexico; (5) inspections on the U.S. and Mexican sides; and (6) trucking from Nuevo Laredo to Monterrey. They located the most serious congestion-causing constraints in the Laredo border crossing, including infrastructure limitations, and costs and time consuming hurdles that take the form of long standing practices of governments, transportation interests, customs brokers, and trade businesses.

The additional times and costs involved in added inspections caused by security concerns in border crossings after the events of September 11, 2001 are not considered in Haralambides, Londoño-Kent paper, but are commented upon in the concluding section.

They obtained quantitative information on costs and times of border crossing through interviews with shippers, truckers, International Trade Data Systems of the U.S. International Trade Administration (ITDS) members, and transport consultants, and verified this information by examining invoices, observing times and movements, and calculating data from maps, traffic engineering and other sources of information.

For our study of measuring the impact of institutional barriers to efficient trucking and their effect in the trade between the United States and Mexico we have adopted the Haralambides, Londoño-Kent findings of inefficiencies in the transport of manufactured products across the Laredo to Nuevo Laredo border. In the GTAP model we simulate the removal of these impediments by imposing a positive productivity shock on goods crossing the border. We then report the effects of the simulation on the five regions of the model (United States, Mexico, Canada, European Union, Rest of World).

Border Crossing Between United States And Mexico

The U.S.-Mexican border is the world's longest between a highly industrialized country and a developing one; 1,933 miles, traversing four U.S. and six Mexican states. This border features sharp differences in economic development, language, political and legal systems, culture, and race. To make things even more complex, Mexico is a major source country for illegal aliens and drugs smuggled into the United States. The diversity in culture, language, and race, along with a war in which Mexico lost half its territory to the United States, and other armed conflicts, present serious challenges to Mexican and U.S. negotiators in their efforts to harmonize the trade facilitation policies across the borders, and differentiates this border from that between the United States and Canada or between pairs of European countries.

Mexico is a very important trade partner of the United States. The total population is 100 million people, with 50 percent under 25 years of age. Mexico City alone (25 million people) has as many people as the whole of Canada. This younger generation is already demanding greater volumes and quality of goods and services. Both countries will benefit substantially from optimizing transport movements and associated logistics of cross-border trade.

Estimation of Cross Border Costs and Times

Haralambides, Londoño-Kent (2002) simulated the movements of a truck transporting shipments from Chicago to Monterrey (i.e. southbound). Figure 1 shows the times and variable transport costs for the Laredo crossing southbound by truck. Each segment of the journey listed below refers to the corresponding movement in Figure 1. These costs are present only when the border crossing is by truck and exclude costs such as *pedimento*,[1] duties, taxes, and broker's commissions (costs that are involved in border crossing regardless the mode of transportation). In their example, the transport of a trailer with products from Chicago to Laredo (in the United States, 1,600 miles) and from Laredo to Monterrey (in Mexico, 150 miles) entails 10 movements of minimum three different trucks and various pieces of equipment for loading and unloading. Figure 1 shows the "current situation" scenario and the breakdown of costs and times for crossing the border southbound. The U.S. long- haul truck is barred from crossing into Mexico, so the U.S. driver leaves the trailer in a U.S. trucking terminal facility (movement 1) and returns with or without trailer (movement 2). If there is a team of drivers, the trip from Chicago to Laredo takes 32 hours, plus or minus two hours; a driver working alone takes about 48 hours, plus or minus three hours (Martinez 1999; Weid 1999). The freight bill averages $1,340, although it does vary somewhat depending on the carrier.

The trailer with cargo to Mexico is moved to the Mexican broker's warehouse facility (in the United States) by a drayage truck[2] (movements 3 and 4). The drayage truck returns empty to its garage (movement 5). The cargo is inspected, counted, and assessed by the Mexican broker to complete the pre-clearance for entry into Mexico, a process that takes from two to five days. The charges include warehousing ($12/night); inspection, classification and, verification ($110-$300); unloading and reloading, ($90-$150); and drayage ($75-$150) for a total of $287 to $ 636.

[1] *Pedimento* is the legal document required for cargo entering into Mexico.
[2] The drayage truck pulls the trailer for the short distance through customs and across the border.

If the U.S. trailer is going into Mexico, there must be an interline agreement between the U.S. trucking company and a Mexican trucking company. Once the pre-clearance process is completed, another drayage truck is called (movement 6) to transfer the trailer through U.S. inspection, cross the bridge, go through Mexican inspection and, finally, enter a designated "corral" (movement 7). The drayage truck returns to the United States with or without cargo or trailer (movement 8). The drayage service charge ranges between $75 to $150. The crossing time varies from 1-8 hours, depending on the time the drayage starts. Mexican brokers do paper work in the morning, so the trucks are released at about the same time for crossing in the early afternoon. The worse congestion is between 1:30 p.m. and 7 p.m., reflecting business practices.

A Mexican trucking company picks up the trailer in the corral (movement 9), and drives the 150 miles to Monterrey (movement 10). This takes from 2.5 to 3 hours and costs from $188 to $210. The total costs range from $1,813 to $2,189.

Figure 2 shows the "current situation" scenario and the breakdown of costs and times for crossing the border northbound (75% from the southbound crossing costs), reflecting the higher costs of the Mexican brokers that operate in the United States.

These figures highlight the inefficiencies in the Laredo border crossing system and raise several questions. If the time and costs of the border crossing far exceed efficient levels, and could be reduced, why has the system remained so inefficient for so many years? Why is the current border crossing system so distant from economic reality? Why does it take longer to travel a few miles near the border than it does to travel from Chicago to Laredo?

Shipping by truck within the United States costs about a dollar a truck-mile. Kenneth D. Boyer (1997) gives a rule of thumb that in the United States it costs one dollar per mile to drive a standard 18-wheel, 80,000-pund truck. Of this dollar, approximately 40 percent goes to the driver, 20 cents are spent on fuel, and the remaining 40 cents are spent on depreciation, licensing, interest on the tractor and trailer, tires, maintenance, and other miscellaneous items. The cost of distance is somewhat higher on international routes, both north and south of the border. However, if we look at the Laredo inefficiencies from a distance equivalent, the border crossing system makes the Rio Grande a very broad river. If border crossings add several hundred dollars in costs, Rio Grande is, from an economic perspective, akin to being several hundred miles wide; time-wise, it is thousands of miles wide. The trucking provisions of NAFTA, if implemented, would have the equivalent economic effect of moving the United States and Mexico closer together by shrinking the economic distance of the Rio Grande to something nearer its physical dimension.

Macroeconomic Effect of the Border Crossing Inefficiencies

The immediate impact of the inefficiencies in the Laredo border crossing is to increase the costs through unnecessary services and the time necessary to cross the border.

The inefficiencies have a secondary impact on overall trade that is more difficult to measure because many other variables affect overall trade. To measure the net impact of the border crossing inefficiencies on the trade between the United States and Mexico we review the literature on border economies and border effects within NAFTA countries focusing on econometric models for measuring the effects of imposing import duty on trade. Then the GTAP model is used to simulate the reduction of border crossing inefficiencies to see what the effects are in the trade between United States and Mexico.

To simulate the reduction in border-crossing costs, we use the GTAP model to simulate augmenting technical change for products imported into Mexico from the United States.[3] The experiment reports the impact on welfare in each of the regions as well as changes in relative trade flows.

The following scenarios are investigated: a) the Mexican tariff on U.S. and Canadian products is increased by the measured friction of border crossing inefficiencies (money paid by shippers for charges for non-essential border crossing services; and b) an iceberg tariff to account for the value of time it takes to cross the border. Then the experiment involves simultaneously removing both (a) and (b). The experiment reports the impact on welfare (EV) as well as relative trade flows.

Overview of Previous Work on Border Economy

In theory, in perfectly integrated markets, prices of similar goods ought to be equalized, when those prices are denominated in a common currency. If the price in one location rose substantially above that in another, market forces would tend to move prices back towards equality. However, empirical studies uniformly find large deviations from the theory. This is the case for NAFTA nations where prices of traded products present big differences, especially U.S.-Mexican relative prices.

Rogers and Smith (2001) estimated the "border effect" on U.S.-Mexican relative prices using consumer price indexes from cities in the U.S., Canada and Mexico, and found that it is nearly an order of magnitude larger than for U.S.-Canada price differentials. They present evidence on alternative explanations of the large border effect for pairs involving Mexican cities. These explanations include sticky prices and variable nominal exchange rates; formal or informal barriers to trade; and labor markets, marketing networks and distribution networks.

They present evidence that the U.S.-Mexican price differential is not primarily due to the differences in U.S.-Mexican wages. Using the prices of 276 highly disaggregated goods and services, they estimated the variability of declines during the stable peso sub-period. The variability on goods and services prices fell by less than the variability of nominal and real exchange rates. Their results are strong evidence of a "nominal border effect" in relative prices within NAFTA that are not explained by the exchange rate differences or the U.S.-Mexican wages.

Rogers and Smith (2001) indicate that other real external influences are important:

1. Even after NAFTA is fully implemented and eliminates formal barriers to trade within the member countries, there are important informal barriers to trade.

2. Marketing and distribution networks are more homogenous within countries than across borders, due in part to language, cultural differences, and tastes. Because of these factors, markets are segmented and prices can differ for identical products across locations.

[3] The technical implementation of this type of productivity=augmenting shock is laid out in Itakura and Hertel (2001). In some sense, this does overstate the benefits of removing the impediment. In the real world, there are certainly those who benefit from the presence of these border frictions. Here we treat the entire friction as a deadweight loss eliminated by productivity-augmenting change, but in reality certain aspects of the frictions resemble a privately-collected tariff accruing on to certain interests at the border. The time lost in transit, though, can justly be characterized as a pure deadweight loss.

3. Labor markets are more integrated within countries than across borders, and this contributes to a large border effect on prices.

Although Rogers and Smith mention generically in (1) the informal barriers to trade, they not provide any substantive analysis regarding their nature, impacts, and how they are established and maintained.

Engels and Rogers (2001) also mention the informal trade barriers that exist, even after NAFTA, as one possible explanation for the relatively large border effect for pairs involving Mexican cities, again without identifying or explaining them.

The advent of NAFTA in 1993, reduced formal trade barriers, and was supposed to result in smoother border crossing. However, the price difference between the United States and Mexico during NAFTA has been higher than in previous years when the exchange rate was more stable. This raises the hypothesis that the non-formal trade barriers have increased after NAFTA, decreasing the positive impact of the reduction of formal trade barriers. The border crossing inefficiencies found at Laredo are important informal barriers to trade and a partial cause of the "real border effect", as are exchange rates, wages, corruption, and the psychological effect of dealing with a market that has a different culture, language, legal and institutional system.

Hummels (1999) estimates that language effects are a significant trade barrier and that speaking a common language lowers costs by an average of 5 percent. The price premia indicate that importers will pay a 3 to 5 percent premium to trade with partners of a common language and 1 to 3 percent premium to trade with contiguous border partners.

The growth of trade between United States and Mexico over the past 15 years has been impressive, but the restrictions on cross-border trucking generate congestion, long waits and extra costs. Both producers and consumers bear the burden of higher transaction costs. The result is that U.S. surface trade with Mexico continues to be markedly more expensive than U.S. trade with Canada, the United States' other NAFTA partner.

Implications of Cross-Border inefficiencies in U.S./Mexico Trade

International trade occurs between nations and the barriers that separate them affect the trade flows. The trade between U.S. and Mexico was over $240 billion in 2001. While the United States represents over 80 percent of Mexico's imports, United States imports have a more diverse origin. In the United States, importing from Mexico represents only 11 percent of the total. Trucking is the main mode of transportation carrying during 2001 $160.6 billion which represents 70 percent of merchandise trade by value, according to the Bureau of Transportation Statistics, U.S. Department of Transportation for 2001 -. Laredo is the most important border crossing point, accounting for 40 percent of U.S.-Mexico overland trade by volume and 50 percent by value ($80.3 billion, $43.3 billion north-bound and $37 billion south-bound). The U.S. Custom service reported that during 2001 Laredo had 2,826,786 truck crossings, 1,419,165 northbound trucks and 1,407,621 southbound trucks, equivalent to 10,000 truck crossings daily, assuming a 5.5 working weekdays with a number of holiday periods. A big percentage of the trucks are empty and create unnecessary congestion. The merchandise is high value cargo, mostly electronics and electric equipment, transportation equipment, etc., with an average value of US$ 30,000 for forty feet Container.

For our study of the implications of border related trade barriers in the trade between the United States and Mexico we take the findings of Haralambides, Londoño-Kent paper.

The time to cross from Laredo to Nuevo Laredo, a 10mile trip, usually takes from 2-5 days and may take longer, and the border crossing services cost between $287 – $636/truck. The border crossing services times and costs include handling costs and associated times of Mexican broker inspections for pre-clearance and storage; costs of loading and unloading; drayage costs and times of border crossing transport; inspections on the U.S. and Mexican sides. These are non-tariff barriers that affect trade. What are the implications of these inefficiencies?

A simple calculation of the microeconomic impact of these extra costs of south-bound border crossings shows that the impact is apparently minimal: $285-$636 of border crossing costs/ trailer, with an average cost of $30,000 cargo/trailer represents from 0.95% to 2.12% percent. But there are also hidden costs: the time waiting to cross, the uncertainty of time the process takes, pollution, congestion from border crossings with empty tucks, corruption, investments in unnecessary infrastructure, and the cost of maintaining the infrastructure.

An increase of 1% to 2% in the costs due to border crossing inefficiencies is insufficient to explain the big price differences observed between United States and Mexico. A more important reason is possibly the time involved.

Hummels (2001) estimates indicate that each day saved in shipping time is worth 0.8 percent *ad valorem* for manufactured goods. Applying this estimate, and considering that manufactures have to wait in Laredo from two to five days to cross the border southbound, this is equivalent to a tariff from 1.6 percent to 4 percent or more, according to the number of days the cargo has to wait to cross the border.

The border crossing inefficiencies in the southbound trade between U.S and Mexico are equivalent to explicit tariffs from 1.8 percent to 6 percent (1- 2% of extra costs charged by Mexican Customs for unnecessary services and 0.8 % per day waiting to cross the border).

The northbound crossing from Nuevo Laredo to Laredo takes less time (1.5 hour – 13.5h) and costs less money ($150 – $300). Hummels (2001) estimates that each additional day spent in transport reduces the probability that the U.S will source from that country by 1 –1.5 percent. This would help explain why vested Mexican interests have introduced border delays in only the southbound direction.

Because of the nature of trade between the United States and Mexico, the removal of the frictions in border crossing will facilitate the integration of the economies of these countries in a more efficient way. Reducing the time and the cost involved in shipping products will help the “just in time process” liberating inventory-holding and depreciation costs on shippers. These border crossing frictions have pronounced implications for trade and the international organization of production.

The United States sources its imports from all over the world. Efficient border crossing operations are important in the northbound crossing, otherwise Mexico risks decreasing its participation in the U.S. Market. This explains in partly explains why the inefficiencies that exist in the southbound crossing are not present in the northbound crossing to the same extent.

The delays are a major contributor to the price difference between the United States and Mexico, introducing extra time, uncertainty and difficulties to manage “just in time” inventories in the industrial processes, impeding a more efficient combination of the factors of production. This is more a question of integration of the economies (medium and long term) and not of trade (over 80 percent of Mexican imports come from the United States and the bilateral trade has grown to $240 billions in the year 2001).

The General Trade Analysis Project (GTAP) Model

We employ the GTAP model and database to measure the implications of border-related trade barriers and to model how reductions in the costs surveyed might impact trade volumes and regional welfare.

Over the last several decades Applied General Equilibrium (AGE) models have become an important tool for analyzing economic issues due to their capability to provide an elaborate and realistic representation of the economy, including relationships among all agents, sectors and other economies.

The GTAP model is a multi-regional AGE model which captures world economic activity in 57 different industries and 66 regions (Version 5 of the database). The underlying equation system of GTAP includes two different kinds of equations. One part covers the accounting relationships to ensure that the receipts and expenditures of every agent in the economy are balanced. The other part accounts for the behavioral equations which are based on microeconomic theory. This is pure simulation that indicates what is the optimal outcome of supply and demand.

We applied the GTAP for the analysis because it includes all the economic factors emphasized in general equilibrium trade theory, versus the partial equilibrium modeling which focuses on a more limited set of factors, such as few products and policy variables.

The GTAP model employs the Armington assumption in the trading sector which provides the possibility to distinguish imports by their origin and explains intra-industry trade of similar products. Thus, imported commodities are assumed to be differentiated from domestically produced goods and combined in an additional nest in the production tree. The elasticity of substitution in this input nest is equal across all uses. The firms decide on the sourcing of their imports and based on the resulting composite import price, they then determine the optimal mix of imported and domestic goods.

The GTAP model has been used by many economists to measure the effects and the impact of new trade agreements. For example, Hertel, Walmsley, and Itakura (December 2001) used a modified version of the GTAP model to evaluate the impact of the FTA between Japan and Singapoore on production, consumption, trade international investment flows, GDP and welfare. They found that the impact of the FTA on investment, capital accumulation and economic growth is significant- particularly in Singapore. They assert that the global benefits from the proposed FTA are substantial, and all regions of the world gain from this agreement, 70 % of the gains are captured by Japan, which is the region undertaking most of the reforms. They focused on the implementation of the FTA considering the “new age” features such as - e-commerce and automating customs procedures – which added facilitate the recognition and calculation of added benefits to other regions and global gains. They recognize that one of the limitations of their study was that they omitted the effects of liberalization of direct trade in transport services, where non tariff barriers are potentially quite large. Even in the e-commerce era, products have to be delivered and transported. Non tariff barriers involved in the transportation services, specially crossing borders, have a big impact not only on trade flows but also on the welfare of the nations.

The Experiment: Simulating Removal of Trade Frictions at the U.S.-Mexico Border

In this experiment we implement the measurement of inefficiencies or border crossing frictions in the U.S.-Mexican border at Laredo, the main crossing point. Inefficiencies here are defined as money paid by shippers for charges for non-essential border crossing services and the times involved in each step of the border crossing operation. Using Haralambides, Londoño-Kent (2002) measurements of border frictions, we simulate their removal as import-augmenting technical change in the GTAP model.

The model used is the GTAP model, version 6.0. An aggregate data set is constructed with 5 countries and 11 sectors, as indicated in Table 1.[4]

Haralambides and Londoño-Kent's surveys have indicated that trade frictions on truck-based imports from the United States to Mexico are approximately equal to a 5% tariff, while northbound trade faces the equivalent of about a 1% tariff due to similar frictions. In order to properly assess the welfare impact of these frictions, we divide the border effect into two components: an iceberg tariff to represent efficiency losses and a normal tariff to represent border frictions where rents can be captured. In Table 1, those sectors predominantly shipped by truck are indicated with an asterisk.

The iceberg tariff captures the inefficiencies of lost time in transit. Following Hummels (2001), we attribute a cost of 0.8% per day to southbound, truck-based trade. We calculate that 3% of the 5% barrier to southbound trade is due to the iceberg tariff, while the remaining 2% can be modeled by a Mexican-imposed tariff on imports from the United States. The barriers to northbound trade are considerably smaller, although nontrivial. The 1% barrier is divided in a similar manner, with 0.75% attributed to a Mexican-imposed export tax, and the remaining 0.25% modeled as an iceberg tariff imposed on U.S. imports from Mexico.

In order to simulate the benefits of removing the costly customs brokerage barriers, we first take the aggregated data set and then recalibrate it to include the import tariff and export tax for U.S.-Mexico trade. This involves adjusting tms(*T*,US, Mex) and txs(*T*,Mex,US) such that the tariffs in the database are 2% and 0.75% higher, respectively. *T* denotes the set of traded commodities predominantly carried by truck between the United States and Mexico.

There is no need to make any similar adjustment for the iceberg tariffs that are to be removed.[5] The variable ams, representing import-augmenting technical change and introduced in version 6.0 of the GTAP model, allows us to simulate the removal of an iceberg tariff by applying a positive shock to the technical efficiency of the trade flow. Essentially, truck-borne goods imported into Mexico become 3% more "efficient" from the Mexican consumer's point of view, while U.S. imports become 0.25% more efficient for the U.S. consumer. Since there are no revenue implications with ams, there is no need to recalibrate the benchmark model.

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[4] The GTAP aggregation file is available by request from the authors.
[5] See *A Note on Changes Since GTAP Book Model (Version 2.2a/GTAP94)*, Ken Itakura and Thomas Hertel, Center for Global Trade Analysis, Purdue University. This is available as GTAP Resource Number 721, http://www.gtap.org.

Results

Table 2 shows a detailed breakdown of the experiment. A summary of the welfare impact of the results of this experiment is given in Table 3. We can see that under these assumptions, the potential benefits from liberalization are substantial for the U.S. and Mexico. Total welfare for Mexico is projected to rise by about $1.8 billion, while the United States benefits slightly less, with an anticipated rise in welfare of about $1.4 billion. The improvement in Mexico's welfare is due, unsurprisingly, to the technical efficiency gains from reducing time in transit (iceberg tariffs). As with all preferential trading arrangements, this bilateral improvement in efficiency leads to some allocative losses from trade diversion. Mexico, too, suffers a modest loss of welfare due to the terms of trade effect, again unsurprising given Mexico's market power in a model with Armington preferences. Investment and savings rise as the returns to capital rise, leading to a modest increase in welfare.

The United States sees a similarly positive outcome, but for different reasons. The reduction in Mexican border frictions leads to a modest increase in allocative efficiency. The gains from technical change from the removal of the iceberg tariff are much smaller than that for Mexico. However, the iceberg being removed is only one-twelfth the size of that faced by southbound shipments. Mexico's declining barriers also lead to a substantial improvement in the terms of trade for the United States, contributing about $1 billion to the U.S. increase in welfare. Investment and savings effects are about the same as in Mexico, modestly improving the overall number.

The welfare impacts for the other countries/regions in the model, however, are negative. Allocative efficiency worsens because of the trade diversion between Mexico and United States (although Canada faces little trade diversion). Terms of trade effects and investment and savings effects are also negative, since both are zero-sum welfare impacts. The global impact is still positive, though, thanks to the improvement in technical efficiency through the shortening of delays at the U.S.-Mexico border.

Trade flows between the United States and Mexico increase substantially thanks to the removal of the border frictions. Quantities traded rise substantially in most sectors, and the total value of trade increases by about $1 billion northbound and $6 billion southbound. Table 4 shows quantity changes, both in value at base-year prices and in percentage terms. The total change in value of goods and services traded is listed in the final row of Table 4. The largest relative expansion in U.S. imports occurs in motor vehicles, with the quantity of imports from Mexico rising by about 5.5%. Electronic Equipment shows a similar increase of about 4.75%. Mexican imports see their greatest increase in Motor Vehicles and Parts, rising by over 16%, while imports of Other Primary Production rise by over 13%. The most substantial increase in *value* of Mexican-bound trade occurs in Other Manufacturing ($3.4 billion in value, not listed in the table). The substantial increases in trade flows are all concentrated in the sectors that use truck transportation and hence subject to removal of significant nontariff barriers to trade in the simulation.

Conclusions

This paper presents the economic implications of the costs and times of crossing the border between the United States and Mexico. While there are other nontariff barriers that have not been considered, such as social, political, infrastructure, corruption, and pollution costs, delays at the border are a major contributor to the price difference between the United States and Mexico. These frictions lengthen delivery schedules, introduce uncertainty into these schedules, and make difficult the implementation of "just in time" inventory management and industrial processes, impeding a more efficient combination of the factors of production. While the U.S. and Mexican economies have already achieved a great degree of integration (over 80 percent of Mexican imports come from the United States and the bilateral trade has grown to $240 billions in the year 2001), removal of border impediments to trade can lead to still greater efficiencies and welfare for both parties. Reducing the time and the cost involved in shipping products will help the "just in time" process, reducing inventory and depreciation costs for shippers. These border-crossing frictions have pronounced implications for trade and the international organization of production. The reduction of border crossing frictions will facilitate a more efficient utilization of the transport equipment, faster equipment turnover and additional savings in capital investments not only in transport equipment but also savings in infrastructure construction, maintenance, and pollution.

For these reasons, we consider our estimates of the gains from improved border crossing a lower-bound estimate. The model as implemented does not consider the impacts of a reorganization of the production process, or the other nontariff implications of trans-border production listed above.

A conservative estimate of the benefits of tighter integration of the economies is that the value of trade between the United States and Mexico will rise by over $7 billion, while welfare in the United States will increase by about $1.4 billion per year, and that in Mexico will rise by over $1.8 billion per year.

While the shipping industry that has blossomed at the U.S.-Mexican border crossing at Laredo no doubt benefits any number of special interest groups in the border trucking and brokering industries, the overall welfare of the two economies is not well-served by the continuation of these artificial frictions at the border. There is no time like the present to finish the NAFTA liberalization process and to remove the not-so-invisible hand slowing trade between the United States and Mexico.

Table 1: Model Regions and Sectors

Regions	*Sectors*[6]
Mexico	Food and Agriculture*
United States	Coal, Oil and Gas
Canada	Other Primary Production*
European Union	Motor Vehicles and Parts*
Rest of World	Petroleum, Coal Products
	Minerals and Metals
	Electronic Equipment*
	Other Manufacturing*
	Transport, NEC
	Sea and Air Transport
	Services and Activities, NES

*Sectors included in set *T*, commodities predominantly shipped by truck.

Table 2: Experiment Structure

	*Variable shocked**	
Barrier	*Southbound*	*Northbound*
Lost time	Δ ams(*T*, US, Mex) = +3%	Δ ams(*T*, Mex, US) = +0.25%
Brokerage frictions	Δ tms(*T*, US, Mex) = -2%	Δ txs(*T*, Mex, US) = -0.75%

**T* is the set of commodities shipped predominantly by truck. See Table 1.

[6] The full aggregation file is available on request from the authors.

Table 3: Welfare Impact of Friction Removal (millions of 1997 dollars)

Region	*Allocative*	*Technical Change*	*Terms of Trade*	*Investment and Savings*	*Total*
Mexico	-137	1962	-82	83	**1826**
USA	73	185	1003	98	**1360**
Canada	-3	0	-75	-7	**-85**
EU	-107	0	-344	-36	**-486**
Rest of World	-137	0	-503	-138	**-779**
Total	-312	2147	-1	-0	**1834**

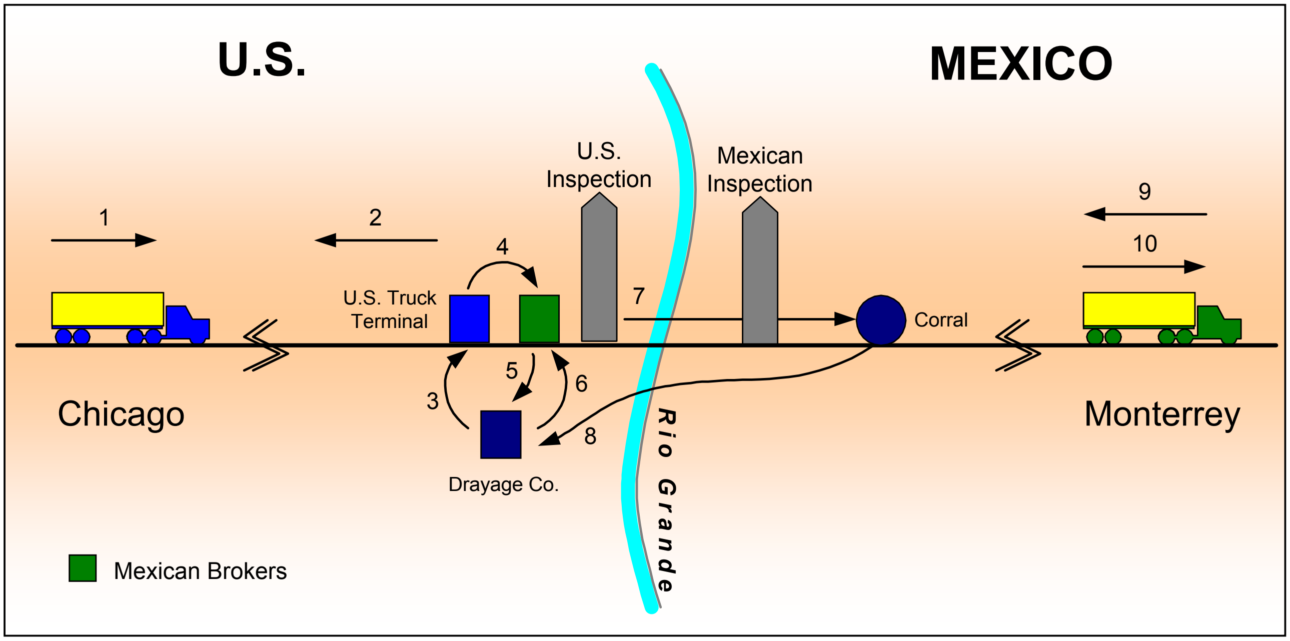
Table 4: Changes in Trade Flows Resulting from Friction Removal

	Mexican imports from the United States		*U.S. imports from Mexico*	
Sector	*Chg. (mill.)*	*Percent*	*Chg. (mill.)*	*Percent*
Food and Agriculture*	419	8.62	-66	-1.40
Coal, Oil and Gas	1	0.70	-35	-0.46
Other Primary Production*	68	13.16	-3	-1.15
Motor Vehicles and Parts*	1230	16.16	763	5.52
Petroleum, Coal Products	-4	-0.30	-1	-0.37
Minerals and Metals	-26	-0.73	22	0.56
Electronic Equipment*	880	7.64	709	4.76
Other Manufacturing*	3339	9.29	-345	-0.88
Transport, NEC	-0	-0.03	-4	-0.94
Sea and Air Transport	-1	-0.32	0	0.01
Services and Activities, NES	7	0.37	-11	-1.20
Total (Δ viws)[7]	6055	8.78	1055	1.21

*Commodities predominantly shipped by truck and subject to liberalization.

[7] Note that the total does not equal the sum of the column above. The rest of the table lists changes in *quantity*, the variable qxs. In the post-simulation environment, however, aggregating across different sectors requires taking into account the relative price changes that have also occurred. Therefore, we provide the sum of viws, the value of import flows.

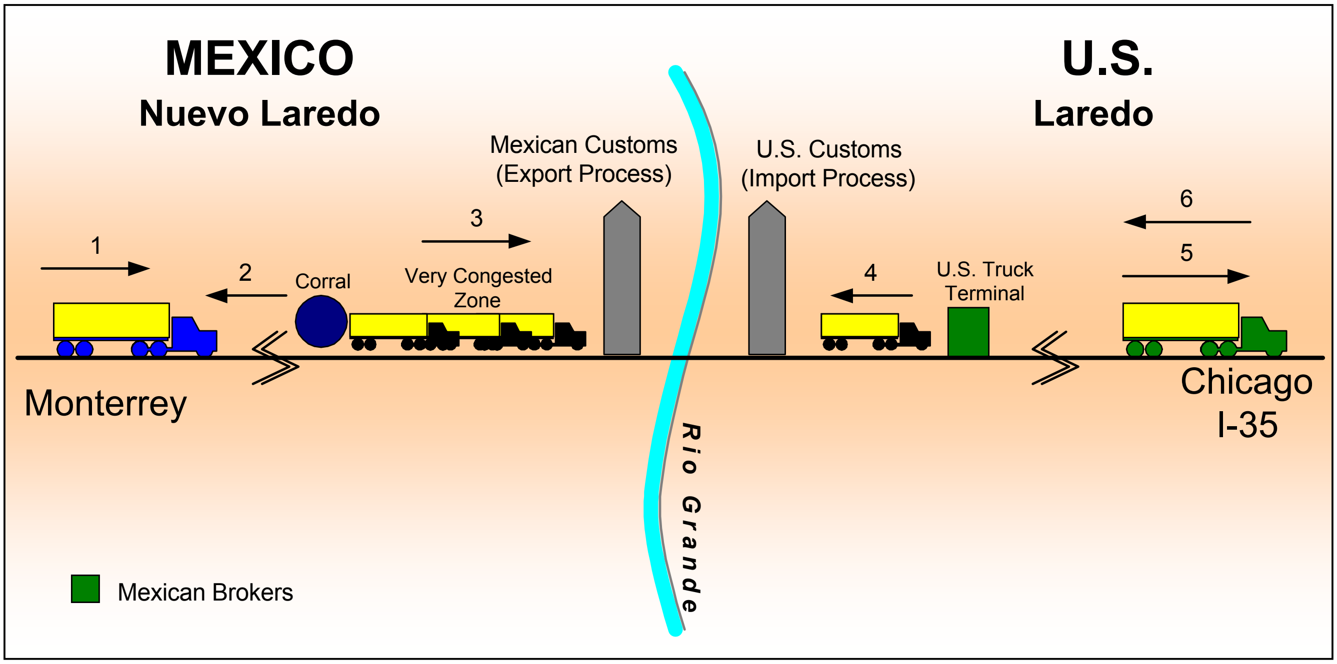
FIGURE 1: Current Situation Scenario Southbound and Breakdown of Border Crossing Costs and Times



	CURRENT SITUATION			
	Costs (US$)		Time (hours)	
	Low	High	Low	High
United States side				
Trucking Chicago-Laredo	1,338	1,343	30.0	51.0
Warehouse ($12/night)	12	36	12.0	72.0
Inspection, classification, verification	110	300		
Unloads and reloads as needed	90	150		
Drayage	75	150		
US inspection			0.0	1.0
Congestion, waiting time			0.0	8.0
Others				
Totals US	***1,625***	***1,979***	***42.0***	***132.0***
Mexican side				
Mexican inspection			0.0	2.0
Unloads and reloads as needed			0.1	0.3
Trucking to Monterrey	188	210	2.5	3.0
Others				
Totals Mexico	***188***	***210***	***2.6***	***5.3***
Total US & Mexico	***1,813***	***2,189***	***44.6***	***137.3***

Source: Figure and Table by Haralambides-Londoño-Kent.

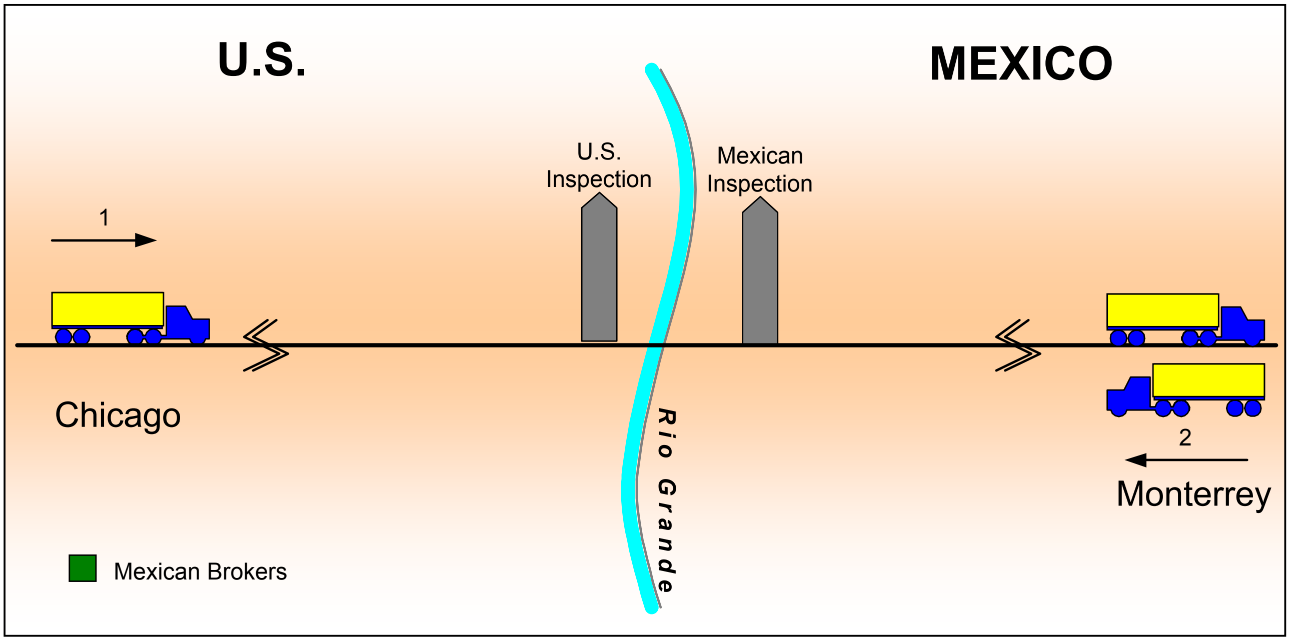
FIGURE 2: Current Situation Scenario Northbound and Breakdown of Border Crossing Costs and Times



	NORTH BOUND			
	Costs (US$)		Time (hours)	
	Low	High	Low	High
Mexican side				
Trucking Monterrey-Border	188	210	2.5	3.0
Unloads and reloads as needed	75	150	0.3	1.0
Drayage	75	150		
Mexican inspection			0.0	2.0
Totals Mexico	***338***	***510***	***2.8***	***6.0***
United States side				
Congestion, waiting time			1.0	6.0
US inspection			0.0	4.0
Unloads and reloads as needed			0.3	0.5
Trucking to Chicago	1,338	1,343	30.0	51.0
Totals US	***1,338***	***1,343***	***31.3***	***61.5***
Total US & Mexico	***1,676***	***1,853***	***34.0***	***67.5***

Source: Figure and Table by Haralambides, Londoño-Kent

Figure 3: NAFTA Scenario
Break-down of Costs and Times Crossing the Border South-bound



	WITH NAFTA			
	Costs (US$)		Time (hours)	
	Low	High	Low	High
United States side				
Trucking Chicago-Laredo	1,338	1,343	30.0	51.0
Warehouse ($12/night)	-	-	0.0	0.0
Inspection, classification, verification				
Unloads and reloads as needed	-	-		
Drayage	-	-		
US inspection			0.0	1.0
Congestion, waiting time			0.0	4.0
Others				
Totals US	***1,338***	***1,343***	***30.0***	***56.0***
Mexican side				
Mexican inspection			0.0	2.0
Unloads and reloads as needed	-	-		
Trucking to Monterrey	188	210	2.5	3.0
Others				
Totals Mexico	***188***	***210***	***2.5***	***5.0***
Total US & Mexico	***1,526***	***1,553***	***32.5***	***61.0***
Potential Savings *(compared with Figure 1)*	***287***	***636***	***12.1***	***76.3***

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