



**Fourth North American Symposium
on Assessing the Environmental
Effects of Trade**

Phoenix / 23 April

08

R E S E A R C H P A P E R

**Transportation Services,
Air Quality and Trade**

DRAFT

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Date:

21 April 2008

This research paper was prepared for the CEC Secretariat as part of its Fourth North American Symposium on Assessing the Environmental Effects of Trade (April 2008). The opinions, views or other information contained herein are those of the author(s) and do not necessarily reflect the views of the CEC or the governments of Canada, Mexico or the United States. This draft paper is made available for discussion at the symposium; a final paper will be published this year. Please do not quote or cite.

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Transportation Services, Air Quality and Trade

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Abstract

Transportation services help the NAFTA economy. Traffic congestion and delays at border ports of entry among NAFTA countries result in two negative consequences of poor air quality and delayed trade flows. Econometric analysis and panel data is applied to assess whether NAFTA resulted in more pollution at border ports of entry related to transportation services and whether policies under NAFTA helped alleviate delays and reduce air pollution at the shared transboundary ports of entry.

Panel data for use consist of variables that include air pollutants, frequency and magnitude of transportation flows (including commercial trucks, passenger vehicles) for ports of entry along both the Canada-U.S. border and the Mexico-U.S. border.

Introduction

The objective of this paper is to assess the environmental impact of trade liberalization on the cross border transportation on two international borders between 3 countries, using econometrics. The focus is on links between transportation related to a the North American Free Trade Agreement (NAFTA) and air quality as the environmental medium to investigate impacts. The concern over air relates to threats to public health from recognized levels of pollutants generated by mobile sources of air pollution such as transportation flows at the land-based ports of entry. At these locations and nearby border metropolitan areas pollution levels exceed air quality standards for carbon monoxide, ozone, nitrogen oxides, particulate matter and sulfur dioxides. The known health effects corresponding with each pollutant are as follows.

Pollutant	Known Health Effects
Ozone	Lung Inflammation, Reduced Lung Capacity, Mortality Respiratory Illness, Asthma Attacks
Particulate Matter	Reduced Lung Capacity, Acute Bronchitis, Respiratory Illness, Mortality, Increased Asthma
Carbon Monoxide	Angina
Nitrous Oxides	Respiratory Illness, Flu, Pneumonia
Sulfur Dioxide	Reduced Lung Capacity, Respiratory Illness

(Fernandez and Keller, 1999).

The introduction includes the following: 1) Background of connections between NAFTA, transportation patterns from trilateral trade at various ports of entry on two international borders and environmental impact (namely, air quality). 2) Discussion of focal questions: Has NAFTA resulted in more air pollution border ports of entry due to traffic? Do policies make a difference for reducing air pollution at the border ports of entry? How does trucking contribute to the correlation of air pollution at border ports relative to other traffic flow? How does it contribute to trade under NAFTA? How might this sector be specifically targeted for reducing environmental impacts? This paper provides answers to these questions through econometric analysis using relevant data.

Following the introduction, Section 2 presents the method and data to carry out the analysis. Section 3 describes the policy options that may be in the discussion stage as well as implementation that are possible ways to mitigate air pollution associated with transportation. Section 4 presents results of the analysis. Section 5 identifies some gaps in the existing literature that warrants further investigation, and summarizes conclusions from this analysis.

The literature on transportation and trade focuses on estimating relationships between economic growth and mobility (Short, 1992). Elasticity estimates such as for OECD countries suggest that each 1% increase in GDP in Europe has been accompanied by an increase of 1.74% in road freight transport and a 1.40 % increase in private car vehicle traffic. Awareness of the consequences of transportation growth and the environment can lead to pondering measures (economic incentives, technology measures, regulations). The 1992 Green Paper by EU for a common strategy may include supply oriented policies related to expansion of infrastructure, managing road access or demand oriented policies of fuel tax, road pricing, emissions standards, carpool lanes and technology policies related to changing fuel and vehicles (Burton and Gillingwater, 1986). Eskeland (1994) describes qualitatively attempts in Mexico City to mix policies that might improve vehicle technology, ease traffic congestion and improve infrastructure. Davis (2006) found no statistically significant effect on ozone levels from a driving restriction program in Mexico City that bans all vehicles from driving one day per week based on the last digit of license.

Many analyses have been focused on studying emissions changes with policies through simulation rather than actual data of ambient pollutants to conduct an econometric analysis comparable to the one in this paper. Small and Kazimi (1999) examine potential changes in emissions in Los Angeles from several policies with a focus on measuring damages, with some assumptions of how humans are exposed to the emissions and how they are valued.

The U.S.-Mexico border is 1950 miles long and the population is 13 million people, largely populating urban centers that are located in pairs facing each other across the international border. There are 14 of these cities. The U.S.-Canada border is 5558 miles long spanning from the Pacific Ocean to the Atlantic Ocean. The majority of international border crossings are east of the westernmost Great Lake in Michigan and Ontario, with Detroit's 2 ports, the Detroit-Windsor Tunnel and Ambassador Bridge dominating all others in terms of volume. The following ports of entry are relevant to the study for the main transportation routes through the urban areas for trade: San Ysidro, Otay Mesa, Calexico, Calexico East, Douglas, Santa Teresa, El Paso 1 and 2, Laredo, Brownsville on the U.S.-Mexico border and Houlton, Buffalo-Niagara, Detroit 1 and 2, Port Huron, Sault St. Marie and Blaine on the U.S.-Canada border.

Air pollutants that are monitored by environmental resource managers at the two North American international borders for setting air quality standards to protect public health include: carbon monoxide (CO), nitrogen oxide (NO_x), ozone (O₃), particulate matter (PM_{2.5} and PM₁₀) and sulfur dioxide (SO₂). The U.S. EPA National Emissions Inventory data suggest that U.S.-Mexico border counties in California and Texas have significantly higher Nox, Pm10 and Pm2.5 emissions than border counties in other states. The greatest amount of NO_x, PM₁₀ and PM_{2.5} emission are found in Arizona, California and Nuevo Leon.

While the time period of interest surrounds the NAFTA, it is important to note the transportation flows that existed long before NAFTA, but also related to trade. In particular, the maquiladora programs starting in 1965, consist of manufacturing assembly

plants for finished products using U.S. raw materials. The land-based border ports of El Paso-Ciudad Juarez, San Ysidro-Tijuana, Nuevo Laredo-Laredo and Ambos Nogales have large numbers of maquiladoras. At Laredo-Nuevo Laredo, it is estimated that 13 percent of northbound trade and 12 percent of southbound trade is associated with maquiladoras (Phillips and Manzanares, 2001).

Laredo in general is the land-based port of entry that receives the largest volume of traffic, where Detroit is second. One reason for this flow is the North American Superhighway Corridor (NASCO) or Mid-Continent Corridor (I-35) that runs from Winnipeg, Manitoba through the U.S. and enters Mexico at the port of Laredo-Nuevo Laredo and runs through to Mexico City.

The CANAMEX Corridor runs from Edmonton, Alberta through the U.S. before crossing the Mexican border at Ambos Nogales and onto Guadalajara. Unlike the Laredo-Nuevo Laredo crossing, the Nogales crossing serves primarily trade between Arizona and Sonora for agricultural supply and consumption. There is seasonal fluctuation in trade and transport along with this agricultural production. (3, ICF)

Motor vehicles and parts are the top traded commodity making up 18% of all commercial value with computer related machinery at 16%. Related to trade volume is the aspect of where trade originates and its final destination, as it then determines which port of entry is optimal. For example, the motor products are mostly traded through the U.S.-Canada border and computer related products rank over motor parts for volume on the U.S.-Mexico border. The San Diego Association of Governments (SANDAG) reports that 34 percent of shipments passing through Otay Mesa, Calexico, and Tecate, California is bound for destinations in S. California. (5, SANDAG). The Bureau of Transportation Statistics also records transborder surface freight data in terms of value.

Historical and projected trade trends in the border region can help determine links to transportation and air quality. Since NAFTA, trade across the U.S.-Mexico border has increased resulting in a scale effect of higher volume of traffic and accompanying air emissions at the border. The U.S.-Mexico Joint Committee on Transportation Planning indicates that U.S. trade has doubled with its two North American neighbors since NAFTA. At a peak in 2005, freight transport carried \$790 billion between U.S., Canada and Mexico (land, air, water based). 62% of this amount was transported by trucks (DOT, 2006). The \$491 billion or 62% of the NAFTA product consists of U.S. imports at \$256 billion, an increase of 8% over 2004 and \$235 billion in exports, a 9% increase over 2004. The value of U.S. merchandise trade with Canada and Mexico has doubled in both current and inflation-adjusted dollars since NAFTA and the accompanying increase in volume that has impacted trade corridors. Canada has been the top trader with the U.S. and Mexico is the second largest trader with the U.S.

Between 2001 and 2005 trade rose at an annual average growth rate of 7% for U.S.-Canada trade and 5.7% for U.S.-Mexico trade. U.S.-Mexico trade reached \$196 million, a 6% increase from 2004 with imports from Mexico increasing 7% over 2004 to \$112 million and exports to Mexico increasing 5% from 2004 to \$85 million. Five million truck crossings including more than 4.6 million containers from crossings between the U.S. and Mexico. Texas had 3.5 of the total 5 million and California had 1.1 million. Laredo had 1.5 million. In 2005 Texas surpassed Michigan in terms of NAFTA trade, \$98 billion and compared to Michigan's \$96 billion and California with \$70 billion (GAO, 2005).

Method

To find answers to the questions posed in the introduction, econometric analysis is conducted with available data rather than simulations. The analysis is aimed at measuring among several possible determinants of port air quality. Comparisons between ports versus baseline cities can be made with data that controls for local conditions to properly measure the correlation between the air quality and traffic flows. An effort is made to control for other sources (stationary sources) by including baseline air quality measures aside from traffic flows at the ports of entry. Ken Small, a leading transportation economist at UC Irvine has concurred that using ambient air quality at ports of entry and controlling for ambient air quality at baseline cities in each country on each side of the border port is valid rather than relying on emission simulations only.

The following is a representation of the primary regression model with variations to be introduced with different policy tests. The left hand side dependent variable of air quality at the port of entry is a function of the right hand side independent variables of air quality at the baseline cities on each side of the border, transportation categories that flow through the border and policy variables to be tested through either binary dummy representation of when the policy was implemented or an actual unit measure of what the policy addresses.

Model 1

$$\log AQ_{it} = \beta_0 + \beta_1 \log AQ_{baseline,t} + \beta_2 \log T_{it} + \beta_3 \log X_{it} + \varepsilon_t$$

where $\beta_0, \beta_1, \beta_2, \beta_3$ are coefficients to be estimated, AQ_{it} is air quality at a port of entry i in time period t , $AQ_{baseline,t}$ is air quality at a baseline city on each side of the border per time period, X_{it} is a binary variable to denote when and where a policy was implemented over the time series for the panel data on various ports of entry on both the Canada-U.S. border and the Mexico-U.S. border, ε_t is a random error. Subsequent models with alter which policy X_{it} is testing. Year dummies are included to capture changes over time in pollution control policies. The hypothesis test is $\beta_3 = 0$, that policy has no effect on air quality at border ports of entry. Factors correlated with air quality including contemporaneous and lagged observed and forecasted weather. Setting a regression in log form is in the interest of comparing relative magnitudes of coefficients with variables that have different units of measure. A log log function form is chosen because factors that affect the uncontrolled pollution levels can have effects that are multiplicative with other effects.

A Durbin Watson measure is included in the econometric regressions to account for autocorrelation.

Data

Time series of traffic flow by month by port of entry along both the Canada-U.S. border and the Mexico-U.S. border is accessed from the Bureau of Transportation Statistics (BTS) with 5 categories of traffic flow, including information on the total volume (number) of trucks, passenger vehicles, buses, empty and full cargo containers. Since all trucks are assumed to make a round trip, and since the majority of these trips are expected to occur at the same border port due to the drayage system, one way trips are an indicator of total traffic at each border port.

The report is different from any previous effort in that there is an effort to distinguish between buses and trucks that are both considered heavy duty diesel vehicles. It helps to ponder aspects of modifying buses as well as trucks to impact air quality as the statistical analysis will show how influential buses can be.

The transportation freight database released monthly by the BTS provides key transportation data and import and export merchandise trade between Canada, Mexico and the U.S. The Transborder Freight data features commodity mode and geographic detail on North American freight movers unavailable from any other source. The Border Crossing Entry data released quarterly by BTS provides counts of commercial vehicles, containers, passengers, and pedestrian traffic at border ports on both borders.

The AQS data is of ambient air quality for 6 criteria pollutants (O₃, CO, PM_{2.5}, PM₁₀, SO₂, NO_x) at monitoring stations at the ports as well as cities on each side of the border port of entry tracked for time periods that could be applied to analyze from 1993-2007 for some pollutants at some ports, but not all pollutants. The following list of ports for each pollutant is to illustrate differences in availability of monitoring data. For the U.S.-Mexico border, San Ysidro, Otay Mesa, Calexico, Calexico East, Nogales, Santa Teresa, El Paso 1 and 2, and Laredo. For the U.S.-Canada border the data is for Blaine, Sault St. Marie, Port Huron, Detroit 1 and 2, and Buffalo.

The wait time data from Customs and Border Patrol covers 2004-2007 and can be used for policies within this timeframe.

Policy Options

The following discussion highlights policies that have been discussed or implemented that may affect transportation related air pollution and sets the stage for the statistical analysis of how effective these policies are with air quality and transportation data.

One test involves the NAFTA policy where the timing of its implementation is noted in the time series that spans the air quality and transportation flows.

For the U.S., the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act addresses 6 criteria pollutants. The U.S. -Mexico border around all the major ports of entry has exceeded the limits (in non-attainment) for one or more of the six criteria pollutants regularly, except Laredo. No border counties are currently out of attainment for Nox and PM 2.5. However, PM₁₀, ozone and others have been more problematic. The ozone standard, the border area has had a 1 hour standard of 0.09 ppm. The NAAQS standard for carbon monoxide (CO) is 9-10 ppm.

For fuel standards, low sulfur diesel with content at or below 15 parts per million was in supply as of July 1, 2006. This is a change from 500 ppm, the previous standard. There has been a phase in for this also until the end of 2009. Therefore, this study tests where the supply has actually been in order to base available time series data on plausible causality of the fuel change variable.

In previous fuel changes, there have been distinct time periods for supply in border cities that may even face each other. Oxygenated fuel to Ciudad Juarez in 1997, 5 years after it was introduced into El Paso provides a useful example of the efforts to modify fuel and what might be the outcome. The availability of the fuel in Ciudad Juarez came about by binational effort through the Joint Advisory Committee to ensure that efforts from one side of the border would not be in vain with reciprocating the effort on

the other side of the border to address ozone and carbon monoxide emissions. The JAC contains government officials, ngos, private sector representatives and public health organizations. The JAC sets out to develop and recommend air quality improvement projects and programs to the Air Work Group established under the 1983 U.S.-Mexico La Paz Agreement. The reauthorization of the Clean Air Act of 1990 introduced a requirement of oxygen content in gasoline in the interest of improving air quality through reductions in emissions of carbon monoxide and reactive organic gases.

Voluntary efforts consist of campaigns such as EPA's Clean Diesel campaign to subsidize retrofit or replacement of technology and vehicles (buses, public vehicles). Arizona Dept. of Air Quality and CARB have retrofit programs too, such as the Carl Moyer Program, the Diesel Risk Reduction Plan from 2000.

Mexico's efforts to encourage policy has been through PROAIRE, air quality programs that focus at the city scale to list actions and entities to be involved. Four cities have these plans that are voluntary without regulatory enforcement rigor (Ciudad Juarez, Tijuana, Mexicali, and Monterrey). Some have started in the late 1990s to write the plans and others have started after 2001. The text of these plans suggests strengthening inspection and maintenance of vehicles and to expedite the crossing at international bridges.

With the decline in dollar value, there's a chance to test if this results in a change in transportation related air quality impacts due to more activity from Canadians and Mexicans in terms of the typical spending they have been documented for regarding commercial activities (including tourism from private vehicle flow). Each border is analyzed separately as the spending amounts for Canadians differ from Mexicans, and the same adjustment in dollar value as of 2006 is made to investigate a new independent variable called spending on the port air quality.

Results

Results from the econometric analysis of transportation, air quality and trade at both the U.S.-Mexico and U.S.-Canada border are discussed in this section and provide several scales of analysis, at individual port levels, at one border level and across the two borders.

A primary step taken in this investigation involves regressing air quality from ports of entry on 5 categories of transportation flow and air quality in baseline cities on each side of the border. This is called step 2. The discussion is organized by pollutant, by port and then moves to a discussion of pollutant by border, called step 3. Then the policy tests follow.

Step 2

For carbon monoxide (CO), Calexico and Calexico East differ as they can be characterized by different traffic flow, where Calexico does not have commercial traffic, but Calexico East does. For Calexico, the U.S. baseline city has a statistically significant contribution to port air quality, but transportation does not. Calexico East port air quality is influenced by statistically significant Mexico baseline city air quality, with bus, private vehicle and truck traffic as statistically significant contributors to port air quality.

Otay Mesa port air quality is influenced by U.S. baseline air quality as well as empty container traffic flow. While at San Ysidro, to the west of Otay Mesa, that does not have commercial truck traffic, the U.S. baseline air quality has a higher magnitude

than the Mexico baseline air quality, that validates meteorological conditions of prevailing north westerly winds out of the U.S. to the North into Mexico to the South.

Laredo port air quality is influenced in a statistically significant way by U.S. baseline city air quality, private vehicles, trucks, buses and empty containers with positive magnitudes and loaded containers with a negative magnitude.

For the Canada-U.S. border, at Port Huron, the Canada baseline city air quality, empty containers and private vehicles are all positive and statistically significant.

For nitrogen dioxide (NO₂), Calexico and Calexico east experience influence from the baseline cities, with the U.S. contributing more to Calexico and Mexico more to Calexico east. The U.S. baseline coefficient is 0.707 in Calexico East with <.001 significance and Mexico baseline coefficient is 0.308 with <.001 significance. The coefficient on empty containers (-0.601) and buses (-0.662) are negative and statistically significant with R squared= 0.89 at Calexico East.

For Otay Mesa, Mexico baseline air quality and empty containers are positive and statistically significant. For San Ysidro, the Mexico baseline air quality coefficient of 0.565 and buses are positive 3.60E-07 and significant. El Paso 1 has the U.S. baseline air quality coefficient of 0.464 and empty containers as positive 0.053 and significant.

On the Canadian-U.S. border, while Detroit 1 and 2 both have the Canadian baseline city with 0.794 and buses with 0.031 as statistically significant contributors to port air quality with R squared=0.79. While buses are significant at Detroit 1, the array of transportation flows is significant at Detroit 2. At Sault St. Marie the Canadian baseline air quality is 0.947 and trucks are positive and statistically significant at 1.012 with R squared=0.99. At Port Huron, the Canadian baseline is 0.952 and trucks are positive and statistically significant at 0.982 with R squared=0.98. Buses and loaded containers are negative and significant with coefficients of -0.033 and -7.11E-08, respectively.

For ozone, Detroit 1 has the Canadian baseline and buses as positive and significant. Detroit 2 has the Canadian baseline and trucks as positive and significant. Loaded containers are negative and significant. While Port Huron has only the Canadian baseline as positive and significant, Sault St. Marie has empty containers and buses as positive and significant along with the Canadian baseline.

On the U.S.-Mexico border, Otay Mesa has both the U.S. and Mexico baseline city air quality as positive and significant as well as loaded containers, while empty containers are negative and significant. San Ysidro has buses as positive and significant. Calexico and Calexico east both are influenced by the U.S. baseline air quality and the east port also has buses and empty containers as positive and significant. Santa Teresa has the U.S. air quality as a larger magnitude than Mexican baseline air quality, buses, empty containers as positive and significant and loaded containers as negative and significant.

El Paso 1 and El Paso 2 also has the U.S. with a larger positive magnitude than Mexico baseline air quality along with empty containers. Loaded containers and buses are negative and significant.

For PM_{2.5}, Calexico has a positive and significant contribution from U.S. baseline air quality with a coefficient of 0.483 with significance <.001. On the Canadian-U.S. border, Detroit 1 has a positive and significant coefficient of 0.544 for the Canadian

baseline, and trucks with a positive and significant coefficient of 0.0008 while empty and full containers are negative and significant at -0.0007 and -0.0006, respectively. Detroit 2 also has buses and private vehicles as positive and significant. Sault St. Marie has loaded containers as positive and significant.

For sulfur dioxide (SO₂), four ports on the U.S.-Canadian border share variables that have positive and significant influence on port air quality. Hence, for Detroit 1 Canadian baseline air quality has coefficient 0.547, empty containers with a coefficient of 1.651E-07 and loaded containers with a coefficient of 1.76E-07. Port Huron has a coefficient for the Canadian baseline as 0.868, 0.180 for empty containers and -0.462 for loaded containers. Sault St. Marie has the Canadian baseline air quality with a coefficient of 1.063, empty containers as 2.862 and loaded containers with 1.212. In the case of Detroit 2, private vehicles also are positive and significant with a coefficient of 8.71.

On the U.S.-Mexico border, San Ysidro has the Mexican baseline as positive and significant at 0.208 while Otay Mesa has the U.S. baseline with a higher magnitude of 0.35 than Mexico baseline of 0.188 for positive and significant influence on port air quality. Otay Mesa also has trucks as positive and significant at 1.15 while loaded containers are negative and significant at -0.809. Calexico east has Mexico baseline as positive as significant at 0.015 along with trucks (8.33E-07), private vehicles (0.037), buses (0.001), and empty containers (1.94E-06). Loaded containers are negative and significant at -1.61E-06. El Paso 1 has the U.S. baseline at 0.889 and summary vehicles as positive and significant with 0.918 and R squared=0.88.

For PM₁₀, the U.S.-Mexico border has San Ysidro with the Mexico baseline of 0.617 and buses at 0.374 as positive and significant. Otay Mesa has the Mexico baseline of 0.635 and loaded containers as positive at 0.665 and significant while empty containers are negative and significant at -0.634. Calexico has the U.S. baseline with a higher positive value of 0.612 and significant magnitude than the Mexican baseline of 0.393. Nogales has the Mexican baseline of 0.674 and loaded containers as positive at 0.001 and significant. Santa Teresa has the U.S. baseline of 0.206 and Mexican baseline of 0.727, loaded containers at 0.939 and empty containers of 14.562 as positive and significant and trucks at -14.572 and private vehicles as negative -14.570 and significant. El Paso 1 has the U.S. baseline as positive at 0.626 and significant and El Paso 2 has buses at 0.079 and empty containers of 0.002 as positive and significant. Laredo has the U.S. baseline of 0.63, trucks at 0.593, private vehicles at 0.001 and empty containers 0.170 as positive and significant while buses at -12.913 and loaded containers at -0.204 are negative and significant.

Step 3

For CO, on the U.S.-Mexico border, Mexico baseline, buses, trucks and private vehicles are positive and significant. There are no measurements for Canada.

For NO₂, there is a basis to compare both borders. For the U.S.-Mexico border, both U.S. and Mexican baseline air quality are positive and significant while buses and empty containers are negative and significant. For the U.S.-Canadian border, the Canadian baseline, trucks, and empty containers are positive and significant. Loaded containers are negative and significant.

For ozone, along the U.S.-Canadian border, the Canadian baseline and trucks are positive and significant, while empty containers, buses and private vehicles are negative and significant. For the U.S.-Mexico border, the U.S. and Mexico baselines are positive and significant, with a larger magnitude for the U.S. Buses are also positive and

significant, while trucks, private vehicles and loaded containers are negative and significant.

For PM_{2.5}, on the U.S.-Canada border, the Canadian baseline, trucks and buses are positive and significant, while loaded and empty containers are negative and significant.

For SO₂, on the U.S.-Mexico border, the U.S. baseline is positive and significant.

Results from Policy Changes

For a test of the effect of the Clean Diesel Policy involving clean fuel, the time period of July 2006 denotes when clean fuel was available for the U.S.-Canada border area. Hence, the effects on PM₁₀ for that border show a positive coefficient of 5.77 with significance 0.005 compared to the magnitude of baseline U.S. air quality positive coefficient of 0.183 with significance 0.003.

The test of having low sulfur gas for more than heavy duty vehicles produces results that have and negative and not significant coefficient for the U.S.- Canada border. Other variables such as Canada baseline air quality (57.98) and empty containers (0.067) still command the positive and significant coefficient magnitudes influencing port air quality in a regression with R squared= 0.91.

One pollutant for which there are significant results on the dollar value change coefficient is CO. On the Mexican border, besides the spending coefficient of 0.129 as statistically significant (0.1335), the Mexican baseline air quality is positive and statistically significant (0.0148) at a higher magnitude of 1.285 while trucks have a negative coefficient of -21.244 and statistical significance of 0.147 and loaded containers have a negative coefficient of -2.84 with statistical significance of 0.0802 (R squared is 0.87).

For PM_{2.5}, both Canada and Mexico indicate a negative and significant spending coefficient (-0.074) with significance of 0.143 for Canada and -0.000006 for Mexico with significance of 0.1207. There are positive and significant coefficients for U.S. baseline air quality 0.446 with significance (0.002) and personal vehicles (coefficient of 0.53) and statistical significance of 0.055 for Canada. For Mexico, trucks have a positive coefficient of 0.0002 with significance of 0.019.

For NAFTA effect on air quality and transportation flows, the results differ by pollutant. For ozone, there is a positive coefficient of 0.039 with significance 0.11. Baseline cities have a larger coefficient for Mexico of 0.262 and the U.S of 0.187 and empty containers of 3.00E-07. For PM_{2.5}, the NAFTA coefficient is positive with 3.23 with significance <.0001 and freight value of 1.65E-07 and significance 0.0082 and trucks with a negative -0.115 and significance 0.001.

For other pollutants the NAFTA dummy variable is not significant and changed signs to negative in the case of NO_x where there was also a high R squared of 0.98. In a more restrictive model without baseline city air quality included, then NAFTA shows a positive coefficient for PM_{2.5} of 3.23 with significance of <.0001 compared to the coefficient of freight value at 1.65E-07 with significance 0.008 and truck coefficient of -0.115 with significance of 0.001.

Conclusions

From this analysis it appears as if even policy that was not specifically targeted to address environmental quality or transportation may have impact in a varied manner at different locations on either the U.S.-Canada and U.S.-Mexico borders.

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