North American Border Trade in a Heightened Security Regime*

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Introduction

A vital component of U.S. foreign trade consists of merchandise trade with Canada and Mexico, where goods shipments must pass through border checkpoints and security infrastructures. The relevance of U.S. trade with these NAFTA (North American Free Trade Agreement) participants is vividly reflected in the following salient statistics:

With respect to Canada:

- the largest U.S. trading partner with peak trade exceeding $400 billion in 2000, tapering off to about $380 billion in 2001 due in part to mutual sluggish economies.
- 83% of Canadian exports go to the U.S. — equivalent to approximately 38% of Canadian GDP.
- 72% of Canadian imports originate from the U.S. — equivalent to about 30% of Canadian GDP.
- the U.S. provides 64% of foreign direct investment in Canada.

* We are grateful to Agnes Gayot for translating the abstract into French.
With respect to Mexico:

- 84% of Mexican exports go to the U.S. — equivalent to about 21% of Mexican GDP.
- 68% of Mexican imports originate from the U.S. — equivalent to about 18% of Mexican GDP.
- the U.S. provides 84% of foreign direct investment in Mexico.

Additionally, of the total North American trade in 2001, 72% was transported by truck, followed by rail (17%), and pipeline (5%) (with air and water transport comprising the remaining portion). Unquestionably, the heightened and intense border security measures imposed in the wake of the September 11, 2001, terrorist attacks particularly impacted truck trade (although rail traffic was also affected), and consequently generated significant negative repercussions with respect to the overall trading volume of the NAFTA participants.

Excluding the immediate period of severe curtailment of border trade in the weeks following September 11th (henceforth designated as simply 9/11), a period of unprecedented trade distortion occurred in the January through August eight-month period, with U.S. trade with Canada in 2002 down by 6.43% relative to the comparable eight-month period of 2001 (prior to the September attacks); and U.S. trade with Mexico was off 2.87% in these identical comparison periods. (These percentage trade reductions are based on data provided by the U.S. Census Bureau, Foreign Trade Division for 1-digit SITC commodities.) This deterioration of trade post 9/11 is particularly striking since in the 1994 through 2000 post-NAFTA period, U.S. trade with Canada grew at an 8.9% average annual rate, and U.S. trade with Mexico grew at a robust 16.0% average annual rate. Note that trading volume had already slowed in 2001, mainly due to the sluggishness of the economies in all three countries—merchandise trade with the U.S. between 2000 and 2001 was off 4.9% for Canada and Mexico combined, with Canadian trade falling by 5.1%, and trade with Mexico dropping 4.7% (data from the Bureau of Transportation Statistics). Of course, a portion of the 2002 downturn in border trade can be attributed to the lingering effects of these 2001 slowing economies, but each of these economies had returned to modest GDP growth in 2002 (expected 2002 GDP growth: U.S. 2.5%, Canada 3.5%, Mexico 1.5%). Consequently, the continued 2002 downturn in trade in a modestly growing economic climate may, indeed, have reflected the impact of the tighter more stringent border security measures.

The intent here is to ascertain whether this is, in fact, the case. That is, has a heightened border security regime implemented in the wake of 9/11 had a significant impact on U.S. border trade over and above the trade effects spawned by the economic environments of the participating countries?

The impact of borders on regional trade (between countries, provinces, states, and so forth) has, and continues to be, widely analysed. A partial list of salient studies includes, but is not limited to, the works of Engle and Rogers (1996), Hazledine (2000), Helliwell (1996, 1998), McCallum (1995), and Nitsch (2002). Not surprisingly, given the abundance of border effect studies based on a spectrum of economic and trade conditions, the estimated impacts of borders on constraining or limiting trade vary widely.

Consequently, various recent initiatives have been undertaken to improve border trade efficiency, generally catalysed by the Smart Border Declaration of December 12, 2001, where the governments of the United States and Canada introduced a 30-point program to enhance border security while maintaining fluid trade and people flow between the two countries. In brief, this “Smart Border” plan offered programs and policies to facilitate the timely, yet secure flow of people and goods across the Canadian border. Elements of the plan include people biometric identifiers (facial recognition, iris scanning), away-from-border truck clearance, remote joint border facilities, shared customs data, infrastructure improvements, intelligent transportation systems employing state-of-the-art electronic technology, and critical infrastructure protection, among others. Vital to these efforts are efficient crossing initiatives that carry an array of acronyms such as NEXUS, FAST (Free and Secure Trade Program), C-TPAT (Customs—Trade Partnership Against Terrorism), PAPS (Pre-Arrival Processing System), PARS (Pre-Arrival Review System) — all of which essentially involve a pre-border crossing clearance mechanism for people and truck traffic.

Even as these innovative and ambitious trade efficiency efforts are being implemented, the purpose of this analysis is to determine if more stringent border security mechanisms imposed in the wake of 9/11 have had a significant negative impact on border trade between the U.S., Canada, and Mexico. In addition to assessing the effects of heightened security on overall trade at each of the northern and southern U.S. borders; the analysis is further refined to analyse whether trade impacts differed between these two major trading partners, whether imports were affected more severely than exports, whether truck transport was, indeed, more harshly constrained than rail, and to identify which products/commodities experienced greater trading volume reductions.

The paper is organised as follows: the analytical methodology is presented in the next section, followed by a description of the data used. A discussion of the key results of the analysis is then presented, culminating with concluding remarks and suggestions for additional pertinent research.

**Methodology**

The model to be estimated is a naive and relatively unsophisticated version of the traditional gravity equation, a ubiquitous model conventionally employed in the analyses of import/export trade and the impact of national borders on this trade. The literature developing, employing, and estimating various forms of a gravity equation is vast. A short list of seminal papers includes, but is by no means exhaustive, the works of Anderson (1979), Bergstrand (1985), Engle and Rogers...
models are estimated employing monthly data (data which will be detailed below): two import models, one capturing Canadian and the other reflecting Mexican goods shipments to the U.S.; and two export models, one reflecting U.S. goods shipments to Canada and the other capturing shipments to Mexico. The import models employ U.S. real disposable income as the economic environment variable, the Canadian export relationship employs Canadian real GDP in this capacity; and for reasons offered above, the Mexican export function employs M2 as the economic environment or spending power variable. For consistency and to facilitate some comparative analysis, the U.S. import and Canadian export models also are estimated employing the respective M2 as the economic environment variable.

The four basic models are then estimated employing truck and rail shipments separately (eight additional regressions); and then further fine-tuned to estimate border trade of the 15 highest dollar volume commodities (60 additional regressions). In short, the refined models capture differing impacts of heightened post 9/11 border security on transportation modes and commodity types.

Data

The merchandise trade data are drawn from the Bureau of Transportation Statistics -- Transponder Freight Data. The data reflect the monthly real dollar value of merchandise trade flows between the U.S. and Canada exclusively, the U.S. and Mexico only, and with the U.S. and Mexico and Canada jointly. The analysis reflects trading behaviour from the January 1, 1998 through August 2002 period -- 56 monthly observations. The late 2001 and 2002 data reveal the trade impact of elevated security and inspection procedures implemented in the wake of September 11th, with the most recent data reflecting trading characteristics nearly a full year beyond the crisis date.

All the economic aggregate data for the U.S. including monthly real disposable income and M2 levels originated from the St. Louis Federal Reserve Bank. The Canadian and Mexican central banks are respective sources for the M2 data of these countries, and the monthly Canadian real GDP data is extracted from the Canadian government's statistical website: StatCan.gc.ca.

Data for the refined trade analysis focusing on the impact of elevated border security measures on particular commodity groups have been compiled from tariff and trade data of the U.S. Department of Commerce, the U.S. Treasury, and the U.S. International Trade Commission (USITC) and extracted from the USITC website.

Real GDP and real personal income data are each in level form, as are the monthly M2 aggregates. Since ordinary least squares estimation would not be optimal due to the presence of autocorrelated errors, we utilize Generalised Least Squares (GLS) to fix the problem of serially correlated error terms. The most common autocorrelated error process is the first-order autoregressive process.

\[
\log I^{CU} = a + b_1 \log Y^{U} + b_2 D + e
\]

\[
\log I^{UC} = a + b_1 \log Y^{C} + b_2 D + e
\]

\[
\log I^{MU} = a + b_1 \log Y^{M} + b_2 D + e
\]

\[
\log I^{UM} = a + b_1 \log Y^{M} + b_2 D + e
\]

\[I = \text{Value of Imports in U.S. dollars (millions); superscripts denote exporting and importing countries, respectively.}\]

\[Y = \text{Equation Measure of income of the importing country.}\]

\[D = 1 \text{ if September of 2001 or later and 0 if before September of 2001.}\]
where errors satisfy $e_i = \rho e_{i-1} + u_i$, and the $u_i$ are independent and identically distributed (iid) as $N(0, \sigma^2)$. The covariance matrix $\Psi$ of the error term $u$ may be written as

$$\Psi = \frac{1}{1-P^2} \begin{bmatrix} 1 & P & P^2 & \cdots & P^{T-1} \\ P & 1 & P & \cdots & P^{T-2} \\ P^2 & P & 1 & \cdots & P^{T-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ P^{T-1} & P^{T-2} & P^{T-3} & \cdots & 1 \end{bmatrix}$$

If we subtract $p$ times equation 2 from equation 1, we get

$$y_t - p y_{t-1} = (x_t - p x_{t-1}) b + \{e_t - p e_{t-1}\}$$

But $e_t = \rho e_{t-1} + u_t$, so the term in braces is simply $u_t$, which is iid by assumption. The parameters of the model depicted in equation 3, are precisely the same as those of the original model in equation 1, and the errors in this model are not autocorrelated. Since we are using an estimate of $p$ instead of a known $p$, this is called a Feasible GLS. The Cochrane-Orcutt (1949) method proceeds to iterate, estimate $b$, compute $p$, use it to get a better $b$, and use it to get a new $p$, and eventually the iterations stop when it reaches convergence.

Results

The focus of the core analysis is simply to determine if the heightened security regime imposed at both the Canadian and Mexican borders in the wake of the September 11th terrorist acts had a significant negative impact on U.S. merchandise trade with these major trading partners.

The regression models are presented in Table 1 through Table 3. A discussion of the major results and inferences follow.

Without question, the tighter border security mechanisms implemented after the September 11th terrorist attacks did significantly dampen border trade over and above the downturn in trade sparked by the sluggish economies of all three trading partners. The binary variable reflecting post 9/11 trade is consistently negative and significant.

Furthermore, it is hardly surprising that the more restrictive border security measures had a more pronounced negative impact on Canadian trade relative to Mexican trade (Table 1). Border trade with Mexico was already subject to more intense scrutiny well before 9/11, essentially as a consequence of elevated U.S. illegal drug detection and confiscation efforts and more determined illegal immigration initiatives. At the time of the terrorist attacks, the U.S. employed about 835 patrol agents and inspectors on the Canadian border, but had about 8,890 agents employed on the Mexican border – Mexican border patrol efforts involved over 10 times the manpower than that which was engaged on the Canadian front. Consequently, heightened security measures imposed on both U.S. borders could be expected to be more detrimental to Canadian trade which was normally not subject to exceptionally stringent security controls. Additionally, Mexican truck trade operated under the Drayage trailing switching system (soon to be extinct). In short, truckers headed either north or south across the border had to relinquish their shipments to a cargo shuttle service to complete delivery – long haul cross border trucking was not permitted due to U.S. fears that Mexican truck safety and environmental guidelines were below standard. This shipping bottleneck had already constrained U.S./Mexican border trade well before the heightened security programs were implemented.

Further, the U.S. government's financial commitment to the legal and judiciary processes and infrastructures required to effectively try and penalize criminals is woefully inadequate on the Canadian border. A report on 60 Minutes (broadcast on CBS in late 2002) stated that the U.S. has committed nearly 10 times the financial resources to Mexican border surveillance and resultant judiciary processes than that designated for analogous Canadian border efforts. In short, the
Mexican border security regime was much more well-developed and entrenched than that which was in effect with Canada, such that heightened post 9/11 border security more severely impacted Canadian trade which customarily operated in a more relaxed mode.

It was widely anticipated that import trade flows into the U.S. would be more constrained than export trade to the NAFTA partners as a result heightened border security measures. The U.S. was the prime target of the terrorist attacks, and it was expected that the Bush administration would be particularly vigilant regarding cargo entering U.S. territory. The results support this perception with respect to Canadian trade as revealed by the binary variable in the models displayed in Table 1.

However, for U.S. trade with Mexico, it appears that exports to Mexico were more negatively impacted by tighter security than U.S. imports from Mexico. As mentioned earlier, imports from Mexico were already subject to vigilant scrutiny stemming from U.S. efforts to combat various forms of illegal activity, and hence may not have reacted as strongly to tightened U.S. security measures. Further, during the 2001 through 2002 period, the Mexican economy exhibited more pervasive and pronounced weakness than either the U.S. or Canadian economies. Following a recessionary 2001, projected Mexican GDP growth for all of 2002 is a meager 1.5% (compared to 3.5% for Canada and the U.S. 2.5%). Also, the Mexican peso has weakened a solid 16% versus the dollar since 9/11 (the exchange rate dropping from 9.33 to 10.82); consequently, the buying power of the Mexican consumers may have been more seriously weakened than the purchasing power of U.S. and Canadian consumers. The relatively more severe deterioration of the Mexican consumers buying power appears to have been manifested in a substantial curtailment of U.S. goods consumption, and reflected in the falloff of U.S. export trade with Mexico. To allow for consistency, all of the models in Table 1 were estimated using the respective M2 as the income variable and there were no appreciable changes in the results.

It is of no surprise that truck trade has been more severely impacted by the elevated security measures than rail transport (Table 2). The accessibility, feasibility, flexibility, and overwhelming abundance of truck transport make this transportation mode the conduit of choice for criminal activity. Consequently, security efforts have primarily focused on truck trade, resulting in a greater falloff in merchandise trade employing this transportation medium even as the away-from-border efficiency clearing programs of FAST (Free And Secure Trade Program), PAPS (Pre-Arrival Processing System), and C-PARS (Canadian Pre-Arrival Review System) have been implemented. Note that for Mexican import trade, rail transport was marginally more impacted than truck trade. But this could have been anticipated given the archaic and cumbersome Drayage trailer switching system had already severely constrained Mexican truck trade prior to 9/11 and the subsequent tightening of border controls.

Table 3 lists commodities which were significantly impacted by the elevated border security mechanisms implemented post 9/11. Needless to say, commodities dangerous in their basic nature (fuel and lubricants, chemicals) and good that are highly conducive to hidden devices, explosives, or tampering (electrical equipment, electrical generating equipment, machinery, transportation equipment) were most impeded by the heightened security measures. Benign commodities such as agricultural produce, livestock, and beverages, etc. were essentially unaffected by the tightened border controls.

### Table 2 Security Impact on Transportation Mode

<table>
<thead>
<tr>
<th></th>
<th>Imports From Canada</th>
<th>Exports To Canada</th>
<th>Imports From Mexico</th>
<th>Exports To Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant</td>
<td>Income</td>
<td>Dummy</td>
<td>Constant</td>
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<tr>
<td>Imports From Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Truck</td>
<td>4.255</td>
<td>0.557</td>
<td>-0.100</td>
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<tr>
<td></td>
<td>(1.104)'</td>
<td>(1.268)</td>
<td>(-2.202)'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.275</td>
<td>0.211</td>
<td>0.032</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-5.102</td>
<td>1.513</td>
<td>-0.108</td>
<td></td>
</tr>
<tr>
<td>Rail</td>
<td>(-0.702)</td>
<td>(1.827)</td>
<td>(-1.301)'</td>
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<tr>
<td></td>
<td>0.486</td>
<td>0.074</td>
<td>0.199</td>
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<tr>
<td>Exports To Canada</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>4.534</td>
<td>0.338</td>
<td>-0.115</td>
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<tr>
<td></td>
<td>(0.756)</td>
<td>(0.773)</td>
<td>(-2.427)</td>
<td></td>
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<tr>
<td></td>
<td>0.453</td>
<td>0.443</td>
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<td></td>
<td>-1.792</td>
<td>0.631</td>
<td>0.038</td>
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<tr>
<td>Rail</td>
<td>(-0.175)</td>
<td>(0.843)</td>
<td>(0.469)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.862</td>
<td>0.404</td>
<td>0.641</td>
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<tr>
<td>Imports From Mexico</td>
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</tr>
<tr>
<td>Truck</td>
<td>-13.104</td>
<td>2.489</td>
<td>-0.110</td>
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<tr>
<td></td>
<td>(-3.346)</td>
<td>(5.577)</td>
<td>(-2.410)</td>
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<td></td>
<td>0.002</td>
<td>0.000</td>
<td>0.020</td>
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<td></td>
<td>-38.548</td>
<td>5.213</td>
<td>-0.151</td>
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<tr>
<td>Rail</td>
<td>(-6.315)</td>
<td>(7.492)</td>
<td>(-2.170)</td>
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<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
<td>0.035</td>
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<tr>
<td>Exports To Mexico</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>1.514</td>
<td>0.493</td>
<td>-0.198</td>
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<tr>
<td></td>
<td>(0.755)</td>
<td>(3.550)</td>
<td>(-3.358)</td>
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<td></td>
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<td>0.000</td>
<td>0.001</td>
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<td></td>
<td>-11.363</td>
<td>1.231</td>
<td>-0.175</td>
<td></td>
</tr>
<tr>
<td>Rail</td>
<td>(-2.067)</td>
<td>(3.238)</td>
<td>(-1.205)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.044</td>
<td>0.002</td>
<td>0.233</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. t statistics are given in parentheses followed by the p-values.
2. Represents real disposable income for U.S.A., real GDP for Canada, M2 for Mexico.
The objective of this study is to assess the impact of the heightened border security measures implemented in the wake of the September 11th terrorist attacks on merchandise trade between the United States and its NAFTA partners. It is thought that this study is one of the first to analyse the repercussions of tighter border security on trade, utilising a full year of monthly trade data subsequent to the 9/11 tragedies. To this end, a simple trade model is employed to highlight the effect of a more stringent security environment on border trade.

The majority of the results were widely anticipated. In short, U.S. trade with Canada was more severely constrained than was U.S.-Mexico trade. A possible explanation for the greater falloff in trade with Canada is that trade with Mexico was already subject to more stringent security measures than those in effect on the Canadian border, whereby Canadian trade flows were more restricted by the heightened security efforts. Given that the U.S. was the prime victim of the terrorist acts, it was expected that U.S. imports would be more negatively impacted than U.S. exports as a result of more vigilant security screening of shipments coming into U.S. territory. Obviously, truck trade was more impacted than rail traffic; essentially because truck is the transportation mode facilitating the overwhelming majority of border trade. Lastly, inherently dangerous commodities such as petroleum products and chemicals or goods more conducive to housing destructive devices such as machinery and electrical equipment experienced greater reductions in trade volume.

### Conclusion

Many other issues and questions regarding U.S. border trade need to be addressed. Is the reduction in border trade simply a short-term exaggerated reaction to aggressive border security efforts in the aftermath of 9/11, or will the current constrained and dampened trade flows linger into the future? Or, when the economies of the NAFTA participants return to historically normal growth levels, will the level of trade rebound to more customary levels, possibly aided by the numerous efficient border efforts either currently underway or in the late developmental stages poised for implementation? To be even more optimistic, might the technological innovations targeted to infrastructure, security and efficiency upgrades facilitate a border environment even more conducive to free flowing goods than that which was in place prior to 9/11? Certainly a continual monitoring of trade flows is warranted, taking particular care to stay abreast of the new program and infrastructure introductions designed to help loosen the restraining grip of the post 9/11 heightened security regime on merchandise trade flows.

### References


