Declining Border Crossings: An Econometric Study of Border Crossings in Whatcom County*

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The number of people traveling across the Canada-US border is much lower today than it was 10-15 years ago even though population has increased and the Canadian dollar is strong relative to the U.S. dollar. Understanding this decline is important if we want to predict the border impacts of events such as the 2010 Olympic Games and the Western Hemisphere Transportation Initiative (the US's passport requirement bill).

For many years it seemed obvious that the number of people crossing the border between Canada and the US was influenced most heavily by the US-Canada exchange rate. When the Canadian dollar was strong in the early 1990s, border crossings were quite high. The Canadian dollar weakened relative to the US dollar in the mid and late 1990s and border crossings fell concurrently. However, when the Canadian dollar began to strengthen in 2003, border crossings did not increase as expected.

While a variety of culprits have been identified (including anti-American sentiment with the Iraq war), most attention has been given to increased border security in the wake of the terrorist attacks on September 11, 2001. For example, *The Economist* (August 2005) described the "unfriendly border" as the reason for

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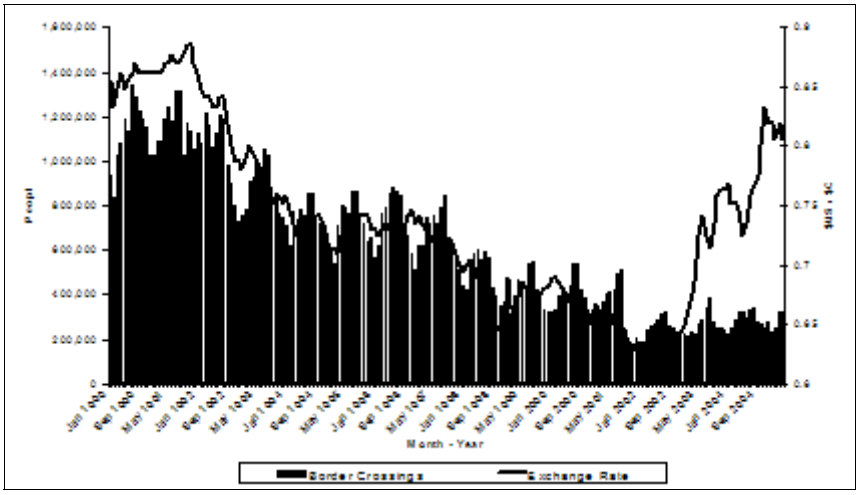

FIGURE 1 Border Crossings and Exchange Rates

decreased border activity between Canada and the US in recent years. If that assessment is correct, we might expect the Western Hemisphere Transportation Initiative to reduce further border activity. We might also anticipate that Nexus and other prescreening programs would gain in popularity and thus result in increased border activity.

Figure 1 shows border crossings and exchange rates from 1990 through early 2005. The figure shows clearly the pre-2002 correlation between crossings and exchange rates, as well as the failure of border crossings to increase when the Canadian dollar strengthened in 2003. The correlation coefficient between border crossings and exchange rates was 0.926 from 1985 through August of 2001, but only 0.397 from October 2001 through May 2005.

Border crossings in this paper are Canadians traveling to the US and returning on the same day at border stations in Whatcom County, Washington.[1] The next section below provides an explanation for the focus on Whatcom County.

The purpose of this paper is to determine the extent to which increased border security has reduced border activity in recent years. The analysis begins by taking as given the notion that changes in border security and perceptions of long delays beginning in September 2001 altered cross border travel patterns. With that starting assumption, data prior to September 2001 are used to predict border activity starting in January 2002. Predicted levels do not track closely with exchange rates – suggesting that factors other than heightened security have caused the decline. The study also confirms that a structural break occurred at that time and offers a quantitative measure of the impact in terms of reduced border activity.

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1. Not including crossings at the Pt. Roberts / Boundary Bay border station. Crossings at this station are not included in the analysis due to the unique nature of Pt. Roberts. The geographic isolation, lack of shopping opportunities, number of Canadians residents, and other features make it possible to exclude data from that one border station.

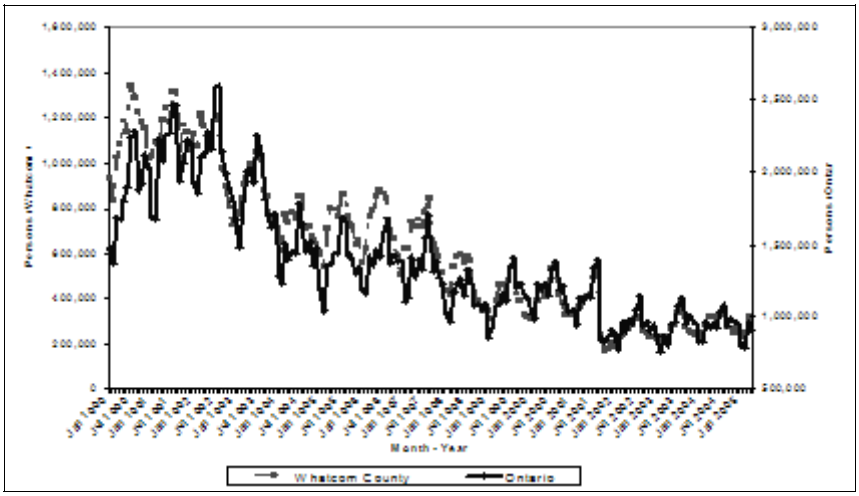

FIGURE 2 Canadian Same-Day Travelers

Focusing on Canadian Same-Day Travelers

Border crossings in this study refer to crossings by Canadians who travel to the US and return on the same day through ports of entry in Whatcom County, Washington. Focusing on Canadian same-day travelers facilitates discussion about changes attributable to September 2001. Border delays can be seen as a fixed cost to a traveler going across the border, which will tend to affect same-day travelers more than other travelers.

Narrowing the focus even more to Canadian same-day travelers at ports of entry in Whatcom County also makes sense because of the dominant role played by Canadians at those ports of entry. In short, Canadian same-day travelers greatly outnumber other types of travelers at Whatcom County ports of entry, such as U.S. same-day travelers or overnight travelers.

It may also be important to note that border crossings in Whatcom County – and crossing by Canadian same-day travelers in particular – mirror border crossings at other stations across the US-Canada border. As such, the focus on crossings in Whatcom County may not be limiting in terms of implications or conclusions. (The primary station in Whatcom County - Peace Arch / Douglas – is the third busiest station in terms of passenger crossings on the entire border.[2]) Figure 2 shows border crossings for Canadian same-day travelers at stations in Whatcom County and in all stations on the border of Ontario, Canada. Border crossings at Niagara, NY and stations in other states/provinces follow the same pattern.

Finally, the focus on Canadian same-day travelers should be viewed as one part of a larger analytical process. Separate models need to be constructed for U.S.

2. The two busiest stations are in Buffalo, NY and Detroit, MI.

same-day travelers and for travelers who stay in either country for more than a day (as motives and influential variables may differ).

The first section below provides an overview of the data, including sources and the manner in which price data are considered in the model. The next section presents the empirical model and results. The last two sections provide an analysis of stability tests for parameters and closing discussion.

Data

Several recent articles offer ideas for variables that should be considered when modeling (either theoretically or empirically) border crossings – especially for Canadians traveling to the US. Vilasuso and Menz (1998) discuss the role of wages and relative prices in explaining spending by Canadians in the US. A Toronto Dominion Economics Topic Paper (March 2005) notes that Canadians now have more shopping alternatives at home – especially with the opening of "category killer" big box stores now open in Canada in recent years. When the volume of border crossings was much higher in the past, companies such as Wal-Mart and Home Depot did not have stores in Canada.

Saba et al (1995) suggest that cigarette prices could also be a factor. They find that border crossings help explain differences in sales of cigarettes across states in the US, implying that cigarettes might be a target commodity for Canadians shopping in the US. It is important to note, however, that when cigarette taxes were reduced in Ontario and Quebec, British Columbia did not follow suite – so the impact of cigarette prices might vary by province. Jackson et al (2003) observe that in addition to certain cigarette taxes, taxes on gasoline in place in Canada in the early 1990s were removed in the mid-1990s. This change increased the relative price of gasoline in the US, thereby reducing the benefit of traveling to the US for shopping and other purposes.

Gasoline prices in Whatcom County have been monitored quarterly since 1990. I convert these figures to monthly values by linear extrapolation and compare those prices to monthly prices in lower mainland British Columbia, provided by the Ministry of Transportation in British Columbia. Actual gas prices in Whatcom County and lower mainland British Columbia are preferred to consumer price indexes for gasoline because the indexes cover larger geographical areas and do not capture local variations.

Prices of other commodities, such as cigarettes, clothing, and milk are based on price indexes for the relevant commodities. All prices are expressed as relative prices, adjusted for the value of the exchange rate. This approach follows the precedent set by Vilasuso and Menz (1998) and Merrifield and Storer (1999), amongst others.

Exchange rate data come from the US Federal Reserve Bank of St. Louis. Monthly rates used in the analysis are simply the average of daily rates for the month. Wage data for workers in BC come from Statistics Canada. Information on store openings was obtained by calling regional or corporate headquarter offices for Wal-Mart, Home Depot, Costco, Best Buy, and Circuit City to document the

days that any of these recognized retailers opened stores in lower mainland British Columbia. Data on border crossings are available from the Canadian government through the Statistics Canada database. Border crossings are also collected regularly by US Customs, with historical records available from sources such as the Whatcom Council of Governments and Western Washington University's Center for Economic and Business Research. Databases are available with border crossings, by month and port of entry, beginning in 1985. Other relevant variables, however, restrict the starting date for the time series. For example, the preferred data for gasoline prices begins in 1990.

Preliminary research and surveys show that the relative price of dairy products and electronics should be considered. Richardson (1998) documents the role of Canadian shoppers in the development of retail areas on Whatcom County. Follow up surveys with managers of the Bellis Fair mall in Bellingham and other stores in Whatcom County reveal that Canadians have, at least in the past, purchased milk and eggs (though regulations allow the transport of only minimal quantities of such goods across the border) and home electronic items while in the US. The purchase of dairy products tended in the past to be at stores very close to the border. Purchases of home electronics and other goods occurred at larger stores in Bellingham, the economic center of Whatcom County. Price indexes for both milk and home electronics are used to include the relative price of these items in the model.

Model and Results

Explanatory variables in the model of Canadian same-day travelers include the relative price of gasoline, milk, cigarettes, and clothing; wages earned by workers in BC, and exchange rates, along with dummy variables to account for both the seasonal variation in the monthly data and the effects of September 2001. Unit root tests confirm that border crossings and many of the explanatory variables are not stationary in levels, but are stationary in first differences. As such, all variables in the model are in differences to ensure stationarity and to reduce problems with spurious correlations.[3] The resulting equation is:

$$\Delta \ln(crossings) = \beta_1 \Delta pricegas + \beta_2 \Delta pricecig + \beta_3 \Delta pricemilk + \beta_4 \Delta pricecloth + \beta_5 \Delta xrate + \beta_6 \Delta storeopen + \beta_7 \Delta BCwages + season\ dummy\ variables + Sept11\ dummy + crossings_{(t-1)} + crossings_{(t-2)}$$

3. Canadian same day travelers from 1990 to 2005 is not a stationary series – as determined by a unit root test. Exchange rates are also not stationary for the same period. However, both are stationary in first differences.

One of the primary objectives of the analysis is to use data through August 2001 to forecast border crossings from 2002 through spring 2005, and to compare that forecast to actual crossings. As such, it is important to construct the most accurate forecast possible.

Seasonal dummy variables are included in the model so that seasonal variation can be explicitly considered in the forecast. Similarly, lagged dependent variables are included to account for the autoregressive structure of the model.[4] Omitted variable bias is a potential concern. Real or perceived delays at the border and anti-American sentiment on the part of Canadians are factors not explicitly captured in the model. Still, it is assumed that the model is correctly specified and that autocorrelation arises because of persistence on the part of travelers. For example, people might believe that their next experience at the border will similar to their last. The autoregressive structure of the model also captures, to a degree, the persistent behavior of business commuters.

It is also important to note that border crossings in the sample are significantly higher in summer than in winter. While the seasonal variation appears to be consistent over time in percentage terms, the absolute variation from season to season has declined along with total border crossings. The model described above is a log-linear model to accommodate this multiplicative form of seasonality. A model with additive seasonality would overstate the seasonal fluctuations in the forecast due to the significant decline in crossings over the study period. Fluctuations in the relative price of gasoline and other items are also much greater at certain times during the study period – requiring that such fluctuations enter the model multiplicatively rather than additively.

As noted above, it is not surprising that a dummy variable for September 2001 is significant in a model of border crossings. This result is to be expected given the fact that the border was closed temporarily and long delays once the border re-opened were advertised frequently. Border crossings recovered partially in October and November 2001 – back to the general downward trend. However, border crossings did not increase when the Canadian dollar strengthened in 2003, begging questions about a structural change in fall 2001. One point made in this paper is that the exchange rate and other variables have different effects on border crossings before and after September 2001. Parameter estimates generated using the full data set differ from parameter estimates using data prior to September 2001 and, separately, after September 2001. (This result is based on an F-test where the unrestricted model is the model using the full data set, except for the month of September 2001, and the restricted model is the combination of the results pre and post September 2001.). Table 1 shows the regression results.

Two things to note in the table are the number of variables that are significant when using data through August 2001 and the fact that the exchange rate is not significant as an explanatory variable when using data from 2002 through 2005.

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4. A correlogram of the residuals from the model without the lagged dependent variable suggests that the residuals follow an AR(2) process. Moreover, the Durbin-Watson statistic does indicate possible autocorrelation when lagged dependent variables are not included.

TABLE 1 Regression Results

Variable	Coefficient Values		
	Data from May 1990 through May 2005	Data from May 1990 through August 2001	Data from January 2002 through May 2005
Relative price of gasoline	0.2123 **	0.1864 **	0.288 **
Relative price of clothing	-0.2037	-0.2388 *	-0.2248
Relative price of cigarettes	0.2748	0.2319	-0.8785
Relative price of milk	0.4721	0.7178 *	0.7893
Wages	0.0029 *	0.0006	0.0048 *
Exchange rate	1.4388 **	1.5168 **	0.8492
Store openings	0.0064	-0.0024	-0.0180
Sept. 11 dummy variable	-0.5459	NA	NA
Crossings (t-1)	-2.45E-07 **	-3.20E-07 **	-2.11E-06 **
Crossings (t-2)	2.26E-07 *	3.12 E-07 **	1.70E-06 **
No. of observations	168	124	40
R^2 (adj.)	0.75	0.75	0.78

Notes: ** = significant at the 95% confidence level or higher
* = significant at the 90% confidence level

These findings give a degree of confidence when constructing a forecast with the earlier data and suggest a possible structural break in late-2001.

Indeed, the possibility of a structural change in September 2001 invites a comparison of actual border crossings from October 2001 to 2005 and crossings forecasted for the same period. Figure 3 shows the predicted and actual Canadian same-day border crossings. The forecasting equation is estimated using data through August 2001 and the forecast is based on actual values of all explanatory variables from October 2001 to present. In addition, lagged dependent variables in the forecast are fitted values, not actual values. Differences between forecasted and actual border crossings provide an estimate of the effects of September, 11 2001 on border crossings for Canadians traveling to the US and returning to Canada on the same day.

On average, forecast values are roughly 50 % higher each month than actual values, with predictable seasonal variation. One interesting feature of the forecast is that it follows the path of observed border crossings much more than exchange rates. That is, the forecasted values do not go up nearly as much as exchange rates in 2003 and 2004. One reason for the limited increase in forecasted border crossings is higher relative gas prices in the US. It is important to note that gasoline

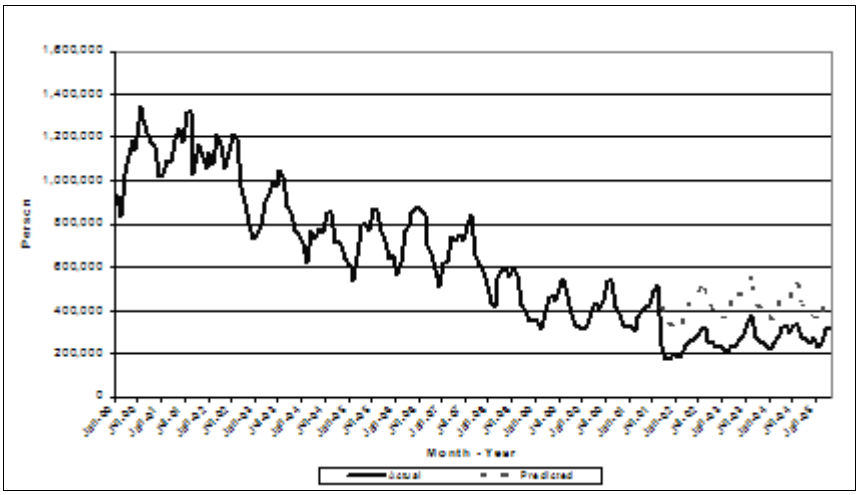

FIGURE 3 Forecasted vs. Actual Border Crossings

prices increased much faster in the latter part of the study period in Whatcom County than in lower mainland BC.[5] As such, it appears that too much blame is placed on border security and not enough attention given to other factors.

While the dummy variable for store openings does have the expected sign, it is not significant. The expectation was that the arrival of new retailers in Canada would have an effect on the behavior of shoppers. It may be that existing stores in Canada, such as Canada Tire and others changed their inventory and customer service practices. The store opening variable in the model does not capture such changes in the Canadian retail sector. Moreover, improvements in customer service in the retail sector in Canada would tend to decrease border activity. Such changes are not captured by the store opening variable.

Another factor in shopper choice is the internet. A news release from Statistics Canada shows that internet purchases in Canada have been increasing, with a significant portion of those purchases from foreign (non-Canadian) web sits. It is possible that being able to make purchases on line has made travel to the US for shopping less appealing. One measure of internet activity considered for this project was gross revenues at Amazon.com. (Data from Statistics Canada on internet use and on line purchases does not cover the necessary years to be included in this study. Data begin in 2001.) Revenues at Amazon.com were not included in the final model for several reasons. While revenues at Amazon.com might serve as an indicator for internet activity in general, there is no obvious link to Canadians. More important is the fact that the steady increase in revenues for Amazon.com from 1996 through 2002 mirrors very closely the steady decline in

5. It may be important to note that gas prices in lower mainland BC have risen noticeably since spring 2005, which is the end date for data in this report.

the value of the Canadian dollar relative to the US dollar. This close relationship between the two variables is problematic for a variety of reasons. Moreover, including the variable lowers the explanatory power of the model.

As noted above, another variable worth considering is the relative price of electronics. The relative price of electronic equipment is also very highly correlated with the exchange rate. The decline in the relative price of electronic equipment in Canada mimics the decline in the exchange rate in the 1990s and early part of this decade. As with revenues for Amazon.com, including the variable lowers the explanatory power of the model and causes the coefficient for the exchange rate to not be significant. The relative price of electronic goods is also not significant when included in the model.

In the 1991 to 2001 sample period, the coefficient for the relative price of clothing is negative and significant at the 90 % level. This finding suggests – rather paradoxically – that as the relative price of clothing in Canada increased, the number of shoppers traveling to the US decreases. It may be that the relative price of clothing is correlated with other factors such as customer service and the arrival of retailers not included in the store openings variable. If this is so, these other factors likely reduce the incentive for Canadians to travel to the U.S.

Finally, it is necessary to determine whether the store openings variable or the relative price of cigarettes should be included in the final version of the model. While the coefficients on these variables are not significant individually, it is still necessary to determine whether they are significant together. An F-test reveals that the model with the variables included is not significant difference from the model with the variables excluded. The variables are included in the final model because various theories suggest that the factors might be important.

Estimating the Structural Break

An article in *The Economist* (August 27, 2005: 31) noted that the correlation between border crossings and exchange rates was so strong in the past that people developed rules of thumb to describe the relationship. One such rule offered in the article was that an increase of 10% in the Canadian dollar against the US dollar would result in a 13 % increase in Canadians traveling south and a 3 % decrease in Americans going north. As such, many people were surprised in 2003 and 2004 when border crossings remained steady while the Canadian dollar strengthened. One explanation for the discrepancy is a change in the way exchange rates affect border crossings, following September 11, 2001.

As noted by Knupling (1997), it is important to determine that a structural change has indeed occurred before analyzing how or when it occurred. The analytical approach described in the sections above assumes that a structural change occurred in September 2001. The break is confirmed by testing the nested null hypothesis of no change in the model (with the hypothesis rejected). That approach, however, does not consider whether the change occurred a little before or after September 2001, or whether changes occurred at more than one point in time.

One way to test the stability of the parameters in a model is to estimate the

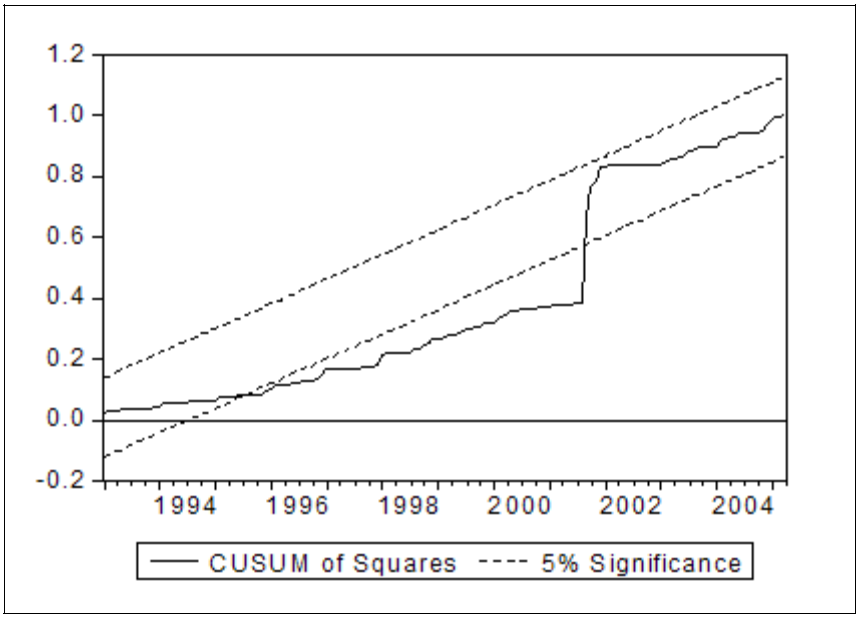

FIGURE 4 Cumulative Sum of Squares Test

equation repeatedly, starting with the smallest possible sample size and adding one observation at a time. At each step in the process the dependent variable can be estimated one period in the future. The residual – the difference between the actual value and forecasted value – can be tracked recursively. The recursive residuals can then be analyzed to see if there are periods within the time series where the parameters seem unstable. (If the model is valid the residuals will have the expected properties. As such, poor performance of the residuals can be taken as a sign of instability in the parameters.) Periods of instability can be taken as a sign of possible structural breaks.

Figure 4 shows the cumulative sum of squares test as described in Brown et al (1975). The vertical axis shows the expected value of the test statistic, the horizontal axis shows time, and the two parallel lines are the 5 % critical lines above and below the expected value. The test statistic for a valid model should fall within the critical lines at least 95 % of the time.

The graph highlights the instability in the model in the third quarter of 2001. The fact that the recursive residuals fall outside the critical lines from 1996 to 2001 could be due to the significant change in 2001. Indeed, a similar graph based on data from 1990 through August 2001 suggests that the parameters are stable up until September 2001.

It is worth noting that similar tests based on data from 1991 through August 2001 and, separately, from 2002 through 2005 suggest that parameters are stable before and after the break in 2001. The cumulative sum of squares in both sub samples are consistently within the 5 % significance bounds.

Conclusions

The evidence strongly suggests that Canadians view border travel differently since September 2001. Changes at the Canada-US border initiated in September 2001 have altered the way that key factors affect border crossings. Yet it also appears that too much emphasis is placed on border security when explaining the relatively low volume of border crossings in recent years. The stronger Canadian dollar should have resulted in more Canadians traveling to the US. However, the influence of the exchange rates has been offset to a large degree by the relative high price of gasoline in the US in recent years and other factors.

The data reveal that only the relative price of gasoline is a significant explanatory variable before and after September 2001. Variables such as the relative price of electronic goods and internet sales are difficult to consider, due in part to their high degree of correlation with exchange rates.

Finally, the structural break that occurred in September 2001 appears to be unique. Parameter estimates are stable from 1990 through August 2001, and again from January 2002 through May 2005 (based on a cumulative sum of squares test). This structural change requires that we revisit many of our established ideas about what factors influence the volume of people crossing the border and consider the legacy effects of September 2001.

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