AN ANALYSIS OF THE CHANGES IN CROSS-BORDER SHOPPING

by

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An essay submitted to the Department of Economics
in partial fulfillment of the requirements for
the degree of Master of Arts

Queen's University
Kingston, Ontario, Canada

August 2010

Abstract

This paper studies the relationship between cross-border shopping by Canadians and the real exchange rate, using the first differences of those series and monthly data from 1972 to present. The Chow test and the Quandt likelihood ratio test are used to test for a structural break in the relationship between cross-border shopping and the real exchange rate and evidence is found of a break at October 2001, after which point the relationship is less strong. Some possible explanations for this change are examined, including behavioral and policy changes following the terrorist attacks of September 11th and changes that have occurred in the Canadian retail market. Evidence is presented which suggests that the Canadian shopping experience is now more competitive with that of the United States, which may have made the amount of cross-border shopping by Canadians less responsive to the real exchange rate.

Acknowledgements

I would like to acknowledge my supervisor Professor Beverly Lapham for providing me with this topic and for her many helpful suggestions while writing this paper.

I would also like to acknowledge my peers in the MA program.

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I. *Introduction*

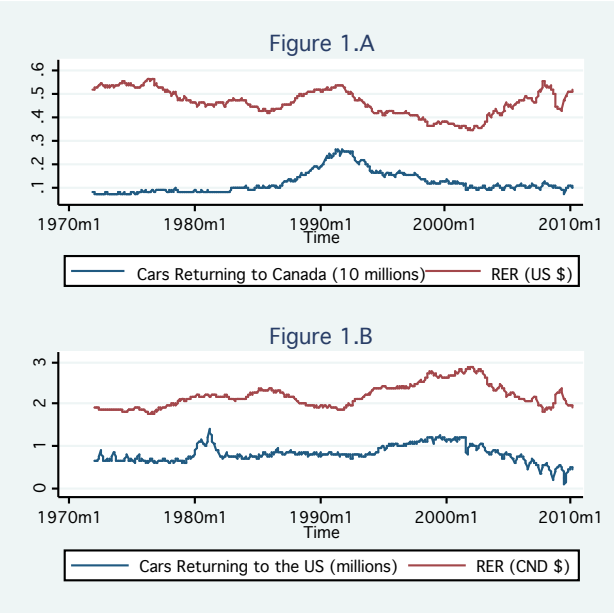
In this paper I study the changes that have occurred in Canadian cross-border shopping over the past three decades. The main focus of the paper is the change in the relationship between cross-border shopping and the real exchange rate that occurred in the early 2000s.

One of the main predictors of cross-border shopping is the real exchange rate between Canada and the United States. The real exchange rate between Canada and the United States, measured in American dollars, is equal to the number of American dollars required to purchase one Canadian dollar, multiplied by the ratio of the Canadian and American price levels (typically measured by Consumer Price Indexes). Both an appreciation of the Canadian dollar and an increase in the Canadian price level or a decrease in the American price level will lead to an increase in the real exchange rate. It is intuitive that when the real exchange rate increases and Canadians are able to purchase relatively cheaper American goods that they may cross-border shop, and that a subsequent decline in the real exchange rate will lead to a fall in cross-border shopping by Canadians.

The standard measure of cross-border shopping is the number of same day return trips by automobile. This data for Canadian and US travelers and the real exchange rate are graphed in Figure 1. There we see that for Canadian travelers the two series appear to move together, with the relationship being particularly pronounced around the 1990s. In recent years the correlation appears to have declined, with the real exchange rate continuing to fluctuate and cross-border shopping remaining relatively low. This poses two interesting economic questions; has the relationship changed and, if so, what would

have caused this type of change? These are the two questions that will be considered in this paper.

Figure 1



The econometric analysis that follows will examine Canadian cross-border shopping from 1972 to the present and test for structural breaks. A base case of national cross-border shopping and its relationship to the real exchange will be presented. This will be followed by two extensions. In the first extension cross-border shopping for each of the provinces possessing a land border with the United States will be considered. In the second extension the real exchange for food and the real exchange rate for clothing will be considered.

The econometric analysis will be followed by a discussion of the possible explanations for the noted changes. First, the effects of the terrorist attacks of September 11th on cross-border shopping will be discussed. Second, the effects of a changing Canadian retail market on cross-border shopping will be presented.

The paper proceeds with a review of related literature in Section II. An overview of cross border shopping is provided in Section III. The data is presented in Section IV and in Section V structural change models are introduced. The empirical analysis and results follow in Section VI. Explanations for a changed relationship are discussed in Section VII and Section VIII takes a closer look at Canadian retail. Concluding remarks and directions for future research are given in Section IX.

II. *Literature Review*

In the late 1980's and early 1990's the amount of Canadian cross-border shopping was steadily rising. It was at this time that much of the early literature on the topic was being published and analysts were trying to determine its causes and effects. However, the change in the trend of cross-border shopping that occurred in the early 2000s has received little attention. One group that has considered this question, in addition to many other border related policy questions, is the Border Policy Research Institute (BPRI) of Western Washington University. I will begin by reviewing some of the earlier studies on cross-border shopping and then move onto the more recent work done at the BPRI.

The literature that was published on cross-border shopping in the 1990s both summarizes the developments to that point and provides some econometric analysis. Ford (1992) reviews some of the main concepts in cross-border shopping and some of the reasons that it rose dramatically around that time and Dallen (1994) examines the link between cross-border shopping and tourism. Di Matteo (1993) analyzes cross-border shopping econometrically. He uses a model where Canadians decide how much to cross-border shop based on relative prices and their incomes and finds that the number of trips

and trip expenditures are very elastic with respect to the real exchange rate and the income of Canadians. The government of Ontario published a report in 1991 in response to the threat to Canadian retailers created by the rise in cross border shopping. The report outlines the potential problems for the province, such as lost sales, decreased employment and lower provincial taxation revenues and suggests some recommendations for combating these problems.

For their Winter 2009 Border Policy Brief the BPRI released a Special Report entitled Trade and Travel Patterns at the Canada – US border: Policy Implications. This publication focused on the pre- and post- September 11th trends in cross-border trade and travel in a particular region and addressed some of the same questions that will be addressed in this paper. The most relevant section of this report concerns "how the historic relationship between the exchange rate and the volume of travel was disrupted in the aftermath of 9/11". It is based on a longer research note by Hart Hodges that was published in February 2006. The purpose of the research was to model Canadian same day border crossings into Whatcom County Washington and to analyze the effects of September 11th. However, the research note only summarizes the results and the econometrics is omitted. To complete the analysis Hodges used the following variables to model border-crossings: the exchange rate, wages in British Columbia, gasoline prices, cigarette prices, clothing prices, milk prices, consumer electronics prices, a seasonal dummy and lagged border crossings. Interestingly, a variable was included to capture the changes in retail because "when border crossings were high in the past, companies such as Wal-Mart and Costco did not have stores in Canada." The dates that "big-box" stores opened in BC were included as variables and were found to be insignificant. Overall,

Hodges determined that September 11th has had a significant impact on Canadian cross-border travel in British Columbia and that the real exchange rate has become less important since then.

The work of the Border Policy Research Institute is an excellent start, but there is still much to be done. This essay will extend the previous work by considering changes in cross-border shopping at the national level and for each province individually and by using a longer dataset that begins in 1972. Additionally, explanations other than September 11th will be considered for why there has been a change in cross-border shopping.

III. *Overview of Cross-Border Shopping*

Let us now return to the graphs of the real exchange rate and cross-border shopping that are presented in Figure 1. Figure 1.A presents the real exchange rate, measured in US dollars, and Canadian cross-border shopping. One can see that between the late 1980s and the early 2000s the two appear to be highly positively correlated and that in the periods before and after this one the correlation appears to be lower. Figure 1.B graphs the real exchange rate, measured in Canadian dollars, and American cross-border shopping. One can see that there is less cross-border shopping by Americans than Canadians and it should be noted that the rise in US trips in 1980 and 1981 was because of lower Canadian gas prices due to the National Energy Program.[1] The graphs for both Canadian and American travelers are included for completeness, but the focus of this essay will be on Canadian travelers.

[1] This detail is taken from Campbell and Lapham (2004).

The BPRI includes some information on the characteristics of cross-border shoppers in their Winter 2009 Border Policy Brief. They find that of the 77 ports of entry or border crossings, located in various provinces across the Canada-US border, the 17 largest handle 86% of cross-border traffic. In 2007 a study was conducted in which 15,000 cross-border travelers at the Cascade Gateway region of the Western border were interviewed to better understand the determinants of cross-border travel. Results showed that 91% of trips are discretionary, including purposes such as shopping, vacations and visiting friends and two thirds of trips do not exceed a distance of 30 miles on either side of the border. These results indicate that shopping is a relevant factor, and would especially be so for the same day series. There is also a tendency for those located close to the border to cross more frequently.

Some models of cross-border shopping were developed in the 1990s, during the period when analysts were very interesting in understanding this phenomenon. (See Dallen (1994) and models by Winter and Jokinen in Ford (1992).) They are still applicable and will aid in understanding cross-border shopping in Canada. The models break up Canada into approximately 3 zones, based on distance in kilometers to the US border or travel time by car to the US border. For example, in Jokinen's model the three zones are 30, 60, and 90 minutes to the border with the fourth being more than 90 minutes to the border. Consumers in the closest zone shop frequently for everyday items and as the distance to the border increases the frequency of trips decreases and the value of purchases increases. In the first zone the everyday items purchased include gasoline, groceries, restaurant meals, alcohol and cigarettes. In the next zones consumers are more likely to purchases goods such as clothes, appliances and electronics. Though

the value of goods purchased increases with distance from the border those close to the border may buy some high value goods on one of their more frequent trips and those far from the border may purchase some everyday goods on one of their less frequent trips (Dallen 1994). These classifications imply that although the types of goods purchased may vary, most Canadians can be classified as cross-border shoppers. In fact, almost 90% of Canadians live within a distance of 100 km from the US border. (Di Matteo, 1993)

IV. *Data*

The dataset used in this paper includes information on the number of cars traveling between Canada and the United States, the nominal exchange rate and various measures of the Consumer Price Index (CPI). It makes use of monthly observations and begins in January 1972 and extends to March 2010.[2]

The data on the number of cars traveling between Canada and the United States is made available by Statistics Canada through the *International Travel Survey: Frontier Counts*. The proxy for cross-border shopping by Canadians that will be used in this paper is the number of Canadian same day return trips by automobile. While data is also available for different trip lengths, same day trips are the best proxy for cross-border shopping because longer trips are more likely to include vacationers.[3] (Data on different trip lengths is included in the Appendix.) A similar measure of cross-border shopping is the number of people returning to Canada by automobile in the same day, but as this is highly correlated with the number of automobiles returning to Canada in the same day the

[2] Note that as this paper was being written later data became available, but March 2010 was maintained as the end date.
[3] The argument that longer trips are more likely to include vacationers is given in Di Matteo (1993).

latter should be sufficient for measuring cross-border shopping by Canadians. (Data on Sthe number of people returning to Canada by automobile in the same day is included in the Appendix.) In addition to the national data, the dataset includes information on the number of return trips by province or territory for those regions that border the United States. The eight regions of Canada possessing a land border with the United States are: British Columbia (BC), Alberta (AB), Saskatewan (SK), Manitoba (MB), Ontario (ON), Quebec (QC), New Brunswick (NB), and the Yukon (YT).

All of the data on automobile border crossings contains seasonality and in 15addition to overall long-term trends there are sharp spikes each summer when Canadians and Americans are more likely to travel. The seasonality must be removed because it provides no extra information and makes it more difficult to identify trends in the data and the relationship with the real exchange rate. To deseasonalize a given series, a set of indicator variables for the months of the year are created and the series is regressed on these dummy variables and the residuals collected. The deseasonalized series is then these residuals added to the mean of the series.[4] Throughout this paper seasonally adjusted time series for all data on border crossings will be used.

Some summary statistics for total return trips and return trips by province or territory are presented below.[5] Note also that graphs of return trips by province or territory are included in the Appendix.

[4] The method to do this and the coding is taken from Baum (2006).
[5] Note that the unadjusted cars series are used for the summary statistics so that true minimums and maximums can be noted. Everywhere else the seasonally adjusted cars series are used.

Table 1

Variable	Obs	Mean	Std Dev	Min	Max
Cars (CAN)	459	1218050	479400	563035	2812170
Cars (BC)	459	288682	171094	76700	782521
Cars (AB)	459	6415	2118	2934	13075
Cars (SK)	459	8862	4257	3343	26382
Cars (MB)	459	22128	8119	8934	56135
Cars (ON)	459	559691	193255	275010	1192894
Cars (QC)	459	120378	53777	48606	339571
Cars (NB)	459	211256	68870	116871	460230
Cars (YT)	459	639	633	12	2629

The real exchange rate data is constructed using data on the nominal exchange rate and price indexes from the two countries. The nominal exchange rate data is available through Statistics Canada and the original source is the Bank of Canada. The Canadian CPI data is maintained by Statistics Canada under the record title *Consumer Price Index (CPI)* and is constructed using a 2005 basket of goods and a base year of 2002. CPI data is collected for all of Canada and for the eight regions considered in this paper. Data on the Canadian CPI for all items and for food items and apparel items is also collected. The provincial CPIs begin in September 1978, so regressions involving these will have slightly fewer observations.

The CPI data for the United States is available through the Federal Reserve Economic Data (FRED) system, which obtains the information from the US Department of Labor: Bureau of Labor Statistics. The base year for the US CPI is 1982-1984 and therefore the US CPI will be consistently higher than the Canadian CPI. However, we are interested in the changes in price level to determine the changes in the real exchange rate so this indexing is not a concern, provided that we use the same base year for all observations of an individual CPI series. The US CPI data is not available with

disaggregation by state, but does include measures of the CPI using a basket of all items, food items and apparel items.

V. *Structural Change*

To determine if there has been a change in the relationship between the real exchange rate and the level of cross-border shopping by Canadians a structural change model is used and structural change is introduced in this section. If the econometric model used to describe a given time series is defined by one parameter vector before a certain point and a different parameter vector after that point, then a structural change is said to have occurred and the change point is known as a structural break. In the analysis that follows, I analyze the data on cross-border shopping and the real exchange rate using a structural change model and use statistical tests to determine break points. As previously mentioned, it appears that the relationship between same day return trips and the real exchange rate is particularly strong over the 1990s and that the relationship is less strong in the periods preceding and following this one. Thus, there is reason to believe that there may have been one or more structural breaks. Figure 1.A suggest that the first possible structural break may have occurred around the late 1980s and the second possible structural break may have occurred around the early 2000s. It is the second possible structural break that will be evaluated in this paper, but the first will also be considered for completeness of data analysis.

To test for structural change both the Chow test and the Quandt Likelihood Ratio (QLR) test (also known as the sup-Wald test) will be used. The Chow test will be considered first and then the QLR test, which is an extension of the Chow test. The

following discussion relies on information presented by Stock (1994) in the Handbook of Econometrics. Let us assume that we have selected an econometric model with a parameter vector ß(t) and that the time series being tested is defined over a range $0 \leq t \leq T$ and the break date occurs at time t=r. The null hypothesis of the Chow test is that ß(t)=ß for all t and the alternative hypothesis is that ß(t)=ß for $t \leq r$ and ß(t)=ß+ø for $t > r$. The test statistic for the Wald form of the Chow test is: $F_T(r/T) = (SSR_{1,T} - (SSR_{1,r} + SSR_{r+1,T})) / ((SSR_{1,r} + SSR_{r+1,T})/(T-2k))$. The Lagrange Multiplier (LM) and Likelihood Ratio (LR) forms of the test are asymptotically equivalent to the Wald form of the test.

When testing for a structural break empirically, one can add to the regression a dummy variable for all $t > r$ and this variable interacted with all slope coefficients and test the significance of the dummy variable and all interacted variables. If a joint significance test is used to determine whether the dummy variable and all interacted terms are significantly different than zero, then this would correspond to testing for a pure structural change in which all parameter values change. One can also test just the dummy variable or just a single interacted term or any combination.

The Chow test is a simple way of testing for structural change, but it requires that the break date is known. Once we begin testing for an unknown break date, the econometrics becomes much more complicated. We have a hypothesized break date of early 2000, but this is not a known break point in the sense that there was a specific exogenous shock, such as a policy change, that happened at that date. We could take September 11th as an exogenous shock and test for a structural break, but we wish to consider other reasons for the change around that time and test multiple potential break points. Stock does mention that to test for an unknown break point, one might estimate

the break point and then use the Chow test. The problem with this method is that since the break point was not chosen independently of the data one may be required to use a different null distribution to determine the significance of the test statistic.

Another way to test for an unknown structural break is to use the Quant Likelihood Ratio (QLR) test. In the Handbook of Econometrics, Stock explains that the QLR statistic corresponds to the greatest F_T statistic for a series of points $t = r_0,\ldots,r_1$ in the interval $0 \leq t \leq T$. The QLR statistic is therefore defined as follows: $QLR=\max_{r=r0,\ldots,r1} F_T(r/T)$. The problem that arises is that the QLR statistic cannot be compared to the same critical values as the test statistic for the Chow test.

In his paper Andrews (1993) determined the appropriate asymptotic null distributions and critical values for the QLR statistic or sup-Wald statistic. Andrews adopts different notation than that used by Stock and defines the entire time interval as πT, with π ranging from 0 to 1. He then defines the following set of test statistics: sup $W_T(\pi)$, sup $LM_T(\pi)$ and sup $LR_T(\pi)$, corresponding to the different test forms. For example, sup $W_T(\pi)$ is the largest test statistic obtained from the Wald test and π represents which point in the time interval is being tested. Andrews explains that the distribution theory is complicated because π is an unknown parameter that is only present under the alternative hypothesis of a structural change. Under the null hypothesis of no change there is no change point parameter and the additional parameter present under the alternative hypothesis leads to a nonstandard distribution for the test statistic. Andrews proceeds to determine the distribution of the test statistic and present tables of the critical values. The distribution of the test statistic is quite complicated and will be omitted, but the critical values will be used later in the paper. The critical values change depending

on the range of π over which one is testing. It may be tempting to us the entire range 0,1 when testing for an unknown break point, but including values near the beginning and end of the time period reduces the power of the test. For this reason it is suggested that one use the interval π=(0.15, 0.85) and omit the first and last 15% of the observations when testing for an unknown break. This corresponds to using critical values of the QLR statistic with 15% trimming. If there is reason to believe that a change occurred within a specific range then one can select a different interval of π.

The difference between the critical values of the Chow statistic and the QLR statistic can be seen as imagining that if more than one possible break point is chosen then greater evidence is needed to reject the null hypothesis that the model parameters are unchanging, so the QLR critical values are greater. Similarly, the QLR critical value for testing over the interval π=(0.15,0.85) is greater than the critical value for testing over the interval π=(0.25,0.75).

When modeling a time series with changes one might think to use a regime change model, as well as a structural change model. In the structural change model there is a break point after which the vector of parameters used to model a given time series changes. A regime change model assumes that the two periods represent two different states or regimes and that the vector of parameters is different in each state. When a regime change model is being used one must estimate the probabilities of switching between various states. In the regime change model there is some probability that the state will change, whereas in the structural change model once a break occurs the new set of parameters can be used to model the given time series indefinitely. A structural change model is used in this paper because there is no strong prior that the series of

cross-border shopping is switching between multiple states.

VI. *Empirical Analysis and Results*

A. *The Empirical Model*

To begin I consider the base case using the time series of same day return trips to Canada by automobile and the time series of the real exchange rate, calculated using CPIs for all goods. First, it must be determined whether the time series of cars and the time series of the real exchange rate are stationary. For both it is not possible to reject the null hypothesis of a unit root. However, the differenced series were found to be stationary and so they will be used in the analysis. I select a model where the differenced series of cars is regressed on the differenced series of the real exchange rate and it can be represented by the equation:

$$\Delta Cars_t = ß_1 + ß_2 \, \Delta RER_t + \varepsilon_t \qquad (1)$$

The dependent variable is the first difference of the cars series and the independent variable is the first difference of the real exchange rate series. Recall that the real exchange rate variable here is defined as the nominal exchange rate in US dollars multiplied by ratio of the price level in Canada to the price level in the US. We would expect that if the real exchange rate is rising and the difference of that series is positive then the cars series would also be rising and the difference of that series would be positive. The results of the above regression for the entire time period are presented in Table 2.

Table 2

ΔCars	Coefficient	P-value
	1725064.00	
ΔRER	(385746.80)	0.00
	652.11	
Constant	(2546.21)	0.80
N=458, R^2= 0.0420		

The constant value is insignificant as we might expect since the series does not appear to be either steadily increasing or decreasing. The coefficient on the differenced real exchange rate is significant and equal to 1,725,064. This would imply, for example, that if the real exchange rate increased by 0.01 one month then the series of cars would increase by 17,250. As the monthly average for cars is 1,218,050 this seems reasonable.

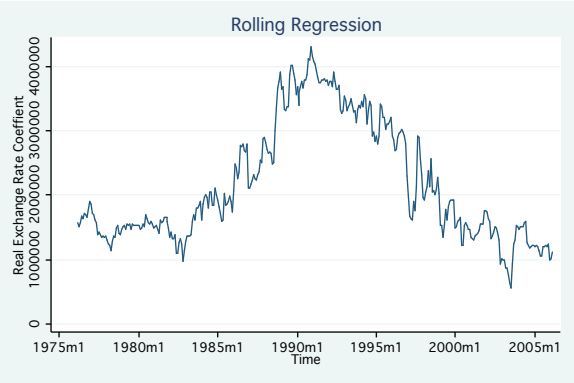
B. *Rolling and Recursive Regressions*

Before any testing is performed on the potential break dates, we can consider rolling and recursive regressions.[6] A rolling regression completes the specified regression for each of a series of data points, so that one can see how the parameters of the model change with time. The method for completing this type of regression is to select a window of width w around the data point for which the regression parameters are being estimated, so that w/2 observations before the data point and w/2 observations after the data point are included in the estimation. For the results shown here the selected window width is 100, so the rolling regression parameter estimates for each point include the 50 observations before and after that point. This implies that the first possible data point is 1972m1+50 = 1976m3. The rolling regression estimates of the coefficient on the

[6] The information on rolling and recursive regressions and the coding is taken from a lecture note by Bruce Hansen, which is posted on-line.

differenced real exchange rate are presented in Figure 2 and are displayed using the middle observation of the window.

Figure 2

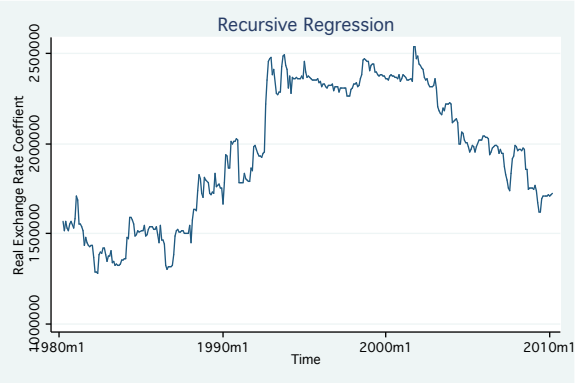


The graph of the coefficient estimates shows us that the slope parameter changes over the time period we are analyzing. The strength of the relationship between cross-border shopping and the real exchange rate peaks around 1990. This is the single peak and the strength of the relationship decreases as the beginning and end of the time period are approached. This provides some evidence that there was a period in the middle where cross-border shopping was highly responsive to the real exchange rate and that in the two outer periods cross-border shopping was less responsive to the real exchange rate.

Recursive regressions are similar to rolling regressions. The recursive regression method also begins with a window of the first w observations, but continues to add one observation until the end of the series. This implies that the first window has a width of 100 and the next window has a width of 101 and so on. These estimates are indexed and displayed using the end of the window. For example, 1972m1+100 = 1980m4 is the end of the first window for the recursive regression. The recursive

regression estimates for the coefficient of the differenced real exchange are shown in Figure 3.

Figure 3



The graph of the recursive regression parameter estimates begins in 1980m4 with the coefficient estimate for the period up to and including that date and shows how the parameter estimate changes as each subsequent observation is included in the estimation. Around the early 2000s the graph begins to be negatively sloped, which implies that including observations after that point decreases the parameter estimate or that the strength of the relationship between the number of cars and the real exchange rate for those points is lower than the average for the points before them.

C. *Testing for Structural Breaks*

Now that we have an idea of how the coefficient on the differenced real exchange rate is changing, we can begin to estimate where the structural break may have occurred. As mentioned earlier, the Chow test is not ideal for testing for an unknown break date and while it is possible to test several possible break points this will alter the null distribution of the test statistic. One solution would be to use the Quandt Likelihood Ratio test. However, the statistical software used in this paper, STATA, does not allow for the computation of this test statistic. As mentioned earlier, computing the QLR

statistic for the inner 70% of the data corresponds to selecting the largest Chow statistic from each of those points. One could build the test by determining the Chow statistic for all of the data points in the inner 70% of the time interval and then finding the largest, which would yield the relevant test statistic. This, however, would be prohibitively time consuming as there are 459 data points in the sample. Instead we use a combination of the Chow and QLR tests and note that the test statistics obtained should be compared with both the F and QLR critical values.

I first test for possible structural change points for the whole series. To do this the Chow statistic is calculated for each year, omitting the first and last 15% of the data points.[7] This means that for each year t it is tested whether there is a break between year t m12 and year t+1 m1. Breaks are tested for each year instead of each month because it reduces the number of tests to a manageable amount. Later in the paper breaks are tested for each month during periods of interest. One can think of this process as first examining the data using a grid that is widely spaced and then re-examining key parts of the data using a finer grid and these decisions are made due to computational limitations.

In Figure 4.A below the test statistics for each year are graphed. A line at the 10% significance level for the F-statistic is included, which is a critical value of 2.71. The only significant result is a test statistic of 3.2 at the year 2001, which implies that the break date was between 2001m12 and 2002m1. Next, recall that observation of the time series for cars and the real exchange rate and observation of the rolling regression results suggest that there may be three periods and two break points over the entire data set. Using the evidence that 2002m1 is the beginning of the third period it is possible to test

[7] Omitting the first and last 15% of the data points would mean that the start and end points for the test would not be points that marked the beginning of a year. To avoid this the nearest year is rounded to and just over 15% of the data points are omitted.

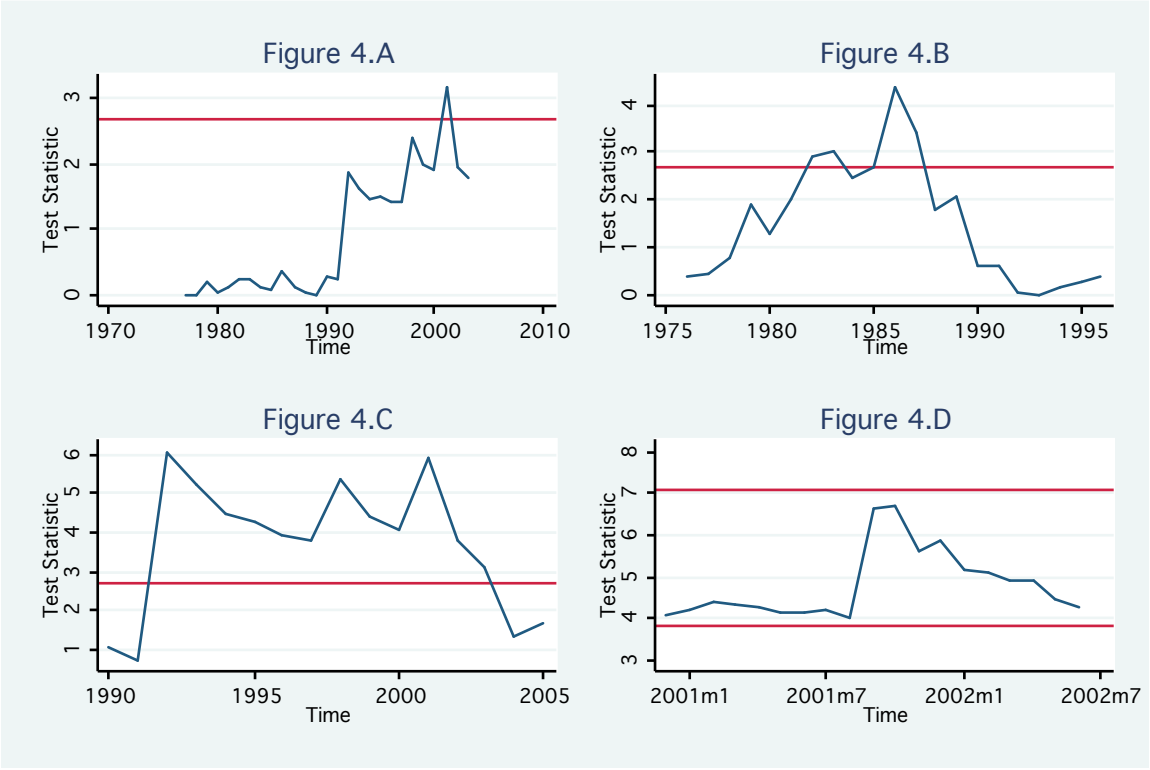
for the first break date over the range 1972m1 to 2001m12. To do this I compute the Chow statistic for each year in the inner 70% of that range. The test statistics are graphed in Figure 4.B below and there is the most evidence of a structural change at 1986 where a test statistic of 4.4 is obtained. It is now possible to test for the second break using the observations from 1987m1 to 2010m3. To do this I compute the Chow statistic for each year in the inner 70% of that range and the test statistics are graphed in Figure 4.C. There is evidence of a structural break at a number of points including 2001.

Now that we have an idea of how the time periods may be broken up, it is possible to focus on the structural break around 2001. Recall that this break happened between 1987m1 and 2010m3, so regressions over this time period are used when testing for the break. Over the range 2000m12 to 2002m6 the finer grid is used and each month is tested as a potential break point. The test statistics are graphed in Figure 4.D below. A line is included at 3.84, which is the 5% critical value of the F-statistic and at 7.12, which is the 10% critical value of the QLR statistic with 15% trimming. The strongest evidence of a break is found at 2001m10 where a test statistic of 6.7 is obtained, which falls between the two critical values.

It should be noted that 2000m12 to 2002m6 actually corresponds to less than the inner 70% of the interval 1987m1 to 2010m3. As this smaller range is being tested we could technically use the QLR test statistics with up to 30% trimming because this would correspond to only observations outside of the relevant range being omitted. However, since this break is being tested for after looking at the data it cannot be considered known and typically one would test the inner 70% of the interval in the case of an unknown break. These other critical values can be noted and taken into consideration, as long as it

is remembered that the critical value with 15% trimming is the largest and most significant. The 10% QLR critical values for 1 restriction and for 30%, 25%, and 20% trimming are 5.93, 6.35 and 6.73 respectively. This means that the break at 2001m10 is significant at the 10% level for the QLR statistic with 25% trimming.

Figure 4



Let us now assume that we have correctly identified the three time periods and two break points. The first period includes the years up to and including 1986, which is the first break point, the second period includes the months up to and including 2001m10, which is the second break point, and the third period extends to the end of the dataset at 2010m3. For the remainder of the essay the focus will be the second break point. In the analysis that follows the time period being analyzed will be restricted to 1987m1 to 2010m3 and only the structural break of the early 2000s will be considered.

To determine how the parameter estimates differ pre- and post-change we can consider regressions for the different time periods.

Table 3

1987m1 - 2010m3			*1987m1 - 2001m10*			*2001m11 - 2010m3*		
ΔCars	Coefficient	P-value	ΔCars	Coefficient	P-value	ΔCars	Coefficient	P-value
ΔRER	1866778.00	0.000	ΔRER	3867695.00	0.000	ΔRER	1036421.00	0.038
	(498784.20)			(994524.00)			(493959.2)	
Constant	-489.48	0.894	Constant	850.18	0.864	Constant	248.47	0.961
	(3670.80)			(4960.95)			(5079.94)	
N=279 R^2= 0.0481			N=178 R^2= 0.0791			N=101 R^2= 0.0426		

Figure 3 presents estimates on subsamples of the data. The estimate for the coefficient of the differenced real exchange rate for the entire period of 1987m1 to 2010m3 is 1,866,778. This is in between the estimates for the pre- and post-break periods. The coefficient estimate for the pre-break period is 3,867,695 and the coefficient estimate for the post-break period is 1,036,421. As we would expect, the value before the break is greater than the value after the break.

D. *Extension One (Provinces)*

We have now analyzed the base case situation and can move on to consider different combinations of the data. Let us begin with the provincial data. For each location we can compare the time series of same day return trips to that province with the time series of the real exchange rate for that province. For each of the eight regions considered, the regression in Equation 1 is estimated using observations from 1987m1 to 2010m3 and the constant and coefficient values are reported, as well as the standard errors. Instead of repeating the process for determining break points from the base case situation above, only the last step of computing the Chow statistics for all data points in the range 2000m12 to 2002m6 will be completed. For each of the eight provinces, the

month for which the greatest test statistic was obtained is recorded and reported as the break date. The value of the test statistic for that month is also recorded. All results are presented in Table 4 below.

Table 4

	Break	Test Statistic	Coefficient	Constant	Regression (N, R^2)
Province					
British Columbia	2001m10	6.78°°°°°	692622.300***	-321.59	279, 0.0392
			(206058.90)	(1496.23)	
Alberta	2001m11	0.76	-4238.12	0.56	279, 0.0028
			(4823.95)	(37.16)	
Saskatewan	2001m7	1.11	13212.210*	-9.94	279, 0.0118
			(7261.85)	(53.89)	
Manitoba	2001m2	5.57°°	52160.870***	-2.20	279, 0.0347
			(16532.64)	(120.49)	
Ontario	2001m9	2.31	807091.500***	243.59	279, 0.0301
			(275179.60)	(2028.25)	
Quebec	2001m2	7.38°°°°°	168410.100*	-156.40	279, 0.0137
			(85750.63)	(643.64)	
New Brunswick	2001m10	2.85°	219039.000***	-225.41	279, 0.0260
			(80565.01)	(605.15)	
Yukon	2002m6	0.41	3207.162**	-0.23	279, 0.0162
			(1499.96)	(11.03)	

Note that *=significant at the 10% level, **=significant at the 5% level, and ***=significant at the 1% level. Note also that the 10% critical value of the QLR statistic with 15% trimming is 7.12 and significance at this level=°°°°°, the 10% critical value for the QLR statistic with 20% trimming is 6.73 and significance at this level=°°°°, the 1% critical value of the F distribution is 6.63 and significance at this level=°°°, the 5% critical value of the F-distribution is 3.84 and significance at this level=°°, and the 10% critical value of the F-distribution is 2.71 and significance at this level=°.

The critical values for the reported test statistics would likely lie somewhere between the F-critical values for the Chow test and the critical values of the QLR statistic with 15% trimming. The F-critical values would be a little low because multiple data points are being tested and the critical values for the QLR statistic would be a little high because not all data points in the inner 70% of the time period are being tested. It is for this reason that we do not use the p-values that are computed by the statistical software and instead use only the test statistics. Recall also the critical values of the QLR statistic

with 20%, 25% and 30% trimming can be used. We are now aware of all of the relevant critical values and can proceed to assess the significance of the test statistics.

The provinces that have test statistics larger than the 10% critical value of the F-distribution are British Columbia, Manitoba, Quebec and New Brunswick. Of these provinces the months for which there is the strongest evidence of a structural break are 2001m10, 2001m2, 2001m2, and 2001m10, respectively. The highest test statistic obtained was a value of 7.38 for Quebec. There is no evidence of a structural break over the period 2000m12 to 2002m6 for Ontario, which is the province with the highest volume of cross-border traffic. Note that included in the Appendix are graphs of the test statistics for each of the eight locations.

E. *Extension Two (Real Exchange Rates)*

The other extension of the base case that will be considered is different measures of the real exchange rate. In the base case situation the real exchange rate is calculated as the nominal exchange rate between Canada and the United States, in US dollars, multiplied by the Consumer Price Index (CPI) in Canada for all goods, divided by the CPI in the US for all goods. It is possible to consider different measures of the real exchange rate by using Consumer Price Indexes for different bundles of goods. In the following analysis the real exchange rate for food, constructed using the CPIs for food items, and the real exchange rate for apparel, constructed using the CPIs for apparel items, will be used in place of the real exchange rate from the base case. It is useful to consider these extensions because food and apparel are two commonly purchased retail items by cross-border shoppers. The regression in Equation 1 is estimated over the range 1987m1 to 2010m3 for each of the two real exchange rates and the constant and

coefficient values are reported. To determine the break date the test statistics for each month over the range 2000m12 to 2002m6 are calculated, as in the extension of the 8 regions. The results are presented in Table 5 below.

Table 5

	Break	Test Statistic	Coefficient	Constant	Regression (N, R^2)
Real Excahnge Rate					
Food	2001m12	4.88^{oo}	1434527.00***	-400.51	279, 0.0039
			(474011.20)	(3701.92)	
Apparel	2001m10	1.19	239699.50	-117.85	279, 0.0320
			(229298.90)	(3755.70)	

Notation as in Table 4.

There is evidence of a structural break in the regression of cross-border shopping and the real exchange rate for food and it is significant at the 5% level of the F-statistic. There is not significant evidence of a structural break in the regression of cross-border shopping and the real exchange rate for apparel. The break for the regression using the real exchange rate for food occurs at 2001m12, which is slightly later then the break for the regression using the real exchange rate for all items.

VII. *Potential Causes of the Change in Cross-Border Shopping*

Now that the data on cross-border shopping has been analyzed and potential structural breaks documented the focus will turn to presenting some hypotheses as to why the changes in cross-border shopping occurred. Before we turn to the second break that occurred in the early 2000s let's recall that there was also a break that occurred in the late 1980s. This break occurred around the time that cross-border shopping was on the rise and many Canadians were worried about the sales revenues that were being lost to

American retailers. The body of literature that was published around this time aimed to explain some of the causes for the popularity of cross-border shopping.

In the 1990s there were many reasons being suggested for the large increase in cross-border shopping that occurred between 1987 and 1991. One of the central explanations was the rise in the exchange rate. The nominal exchange rate rose from 0.71 US dollars for each Canadian dollar in November 1986 to 0.89 US dollars for each Canadian dollar in November 1991. This appreciation of the Canadian currency increased the purchasing power of Canadian consumers. This and the explanation that prices are lower in the United States are both captured by the real exchange rate in our analysis. It was also argued that American retailers carried a greater variety of products and offered better service. Another development that was being noted as a possible explanation was The Free Trade Agreement (FTA), which became effective January 1st 1989 and led to reduced tariffs and duties on some goods. It was suggested that the FTA made Canadian consumers more aware of the American retail market, which increased cross-border shopping. However, it could also be argued that lower tariffs would allow Canadian retailers to carry more of the products offered in the United States, which would reduce cross-border shopping. Some of the other suggested reasons for the increase in cross-border shopping included the introduction of the GST in 1991, the lack of Sunday shopping in Ontario until the summer of 1992 and American retailers marketing to Canadian consumers. A final idea that was being mentioned was the "lack of enforcement of tax collection at the border". All Canadians who return from the United States in the same day must pay the applicable duties and taxes on the items that they purchase. However, waits of several hours would develop at border crossings if

officials were to search even a quarter of the cars, which makes it impossible to collect the necessary taxes 100% of the time. (Dallen, 1994)

Now that some of the historical reasons for changes in cross-border shopping have been presented, the task is to discern what may have caused the changes in cross-border shopping that occurred in the early 2000s. First the terrorist attacks of September 11th will be considered and then the changes in the Canadian retail market will be considered.

It is a popular hypothesis that the increased border security following September 11th reduced the amount of cross-border shopping. If one wishes to assess the validity of this hypothesis then the exact timing of the events should be reviewed and the information that follows was taken from an article on the Immigration.ca website, prepared by Colin R. Singer. Prior to September 11th, border policy was being created in the spirit of making travel between Canada and the United States increasingly efficient and the US Free Trade Agreement of 1989 and the North American Free Trade Agreement of 1994 added to a sentiment of economic partnership between Canada and the United States. There was a change in attitude after September 11th and American policymakers were highly interested in security, even at the expense of efficient trade and travel. The two policy responses to the increased security threat were the "Smart Border" declaration in December 2001 and the Security and Prosperity Partnership of North America in 2005. Both had the goal to strengthen security, but not adversely affect the mobility of people and goods. The bill requiring all individuals entering the United States to show a passport was The Western Hemisphere Travel Initiative. The intention was for the bill to become effective December 31st 2006 for sea and air travel and

December 31st 2007 for land travel. Canadian and American businesses were opposed to this bill because it might discourage people from making cross-border trips for the purpose of shopping or tourism and due to the influence of US politicians there was an extension until June 1st 2009.

Many of the effects of September 11th may have led to fewer Canadians crossing the border. The heightened border security would have created longer waits at border crossings, which may have caused some people to travel less frequently. Additionally, the increased intensity of screening by border officials may have deterred some individuals from making cross-border trips. Finally, the passport law would have affected those without a passport or those traveling with someone without a passport. The first two effects would likely have been the strongest immediately following September 11th and may have become less important as people adapted to the new security measures and policies were put into place more efficiently. The passport law would have had the strongest effect after it was enacted in June 2009. It is possible that it may have influenced cross-border shopping earlier due to confusion over when it was to become effective, but this would still only date back to December 2007. The fact that the strength of the relationship between cross-border shopping and the real exchange rate has been decreasing since early 2000, and the effects of September 11th are unlikely to have lasted that entire period, indicates that there may be more to the explanation.

There are two interesting results from the empirical analysis that suggest September 11th may not have been the only factor responsible for the change in the relationship between the real exchange rate and the number of cross-border trips. The first is that the location of the change within the range of months considered is not the

same for all provinces, which may suggest a gradual change that affected regions differently. The second is that the month with the strongest evidence of a structural break for both Manitoba and Quebec is 2001m2, which means that September 11th could not have caused that break point. These results suggest that September 11th was not the only factor and other factors, such as the change in the Canadian retail market, may have been important.

The retail market in Canada has been changing over the past two decades. Some of the biggest changes include the introduction of the big-box style of retailing and the entrance of large American retailers. It is possible that these changes have made the Canadian shopping experience more competitive with that of the United States and have led to decreases in the amount of cross-border shopping by Canadians. The retail explanation and the explanation of September 11th do not have to be mutually exclusive. The changing retail market would create a gradual change in cross-border shopping trends, with new stores and new retailing strategies entering different areas at different times and consumers requiring some time to adjust their habits. As mentioned above, the large exogenous shock of September 11th would cause a more abrupt change in the series of cross-border shopping. This implies that the two could have been happening simultaneously and there would be evidence of a change in the series of cross-border shopping for a period around when the retail market was transforming and extra evidence of a change around September 11th.

It is not immediately clear how a retail market that is more competitive with that of the US would cause the observed changes, namely a decline in cross-border shopping and less responsiveness to the real exchange rate. One might argue that the real exchange

rate is a proxy for price differences between shopping in the US and shopping in Canada and that the shopping experiences in Canada and the US can be viewed as two competing goods. Using this model set-up, increased responsiveness to prices would indicate that the two goods had become closer substitutes, while decreased responsiveness to prices would indicate that the goods had become more differentiated. The changes that have been noted in this paper would correspond to the latter case.

The problem with the above reasoning is that it does not take into account the set of fixed costs and benefits associated with cross-border shopping. If one decides to cross-border shop then there is a certain set of fixed costs associated with that decision, including the time cost of traveling to the foreign destination, the additional cost of gasoline resulting from the increased distance, and the nuisance of crossing the border. These costs are obviously proportional to ones distance from the border and the distance from the border to the foreign retail destination. However, it is safe to assume that the costs are always greater when shopping across the border, as opposed to shopping domestically. These costs are fixed and do not vary with the real exchange rate. In fact there exists both this fixed cost and a fixed benefit, in addition to the variable effect of real exchange rate fluctuations. The fixed benefits to shopping in the United States include better product variety, preferred retailers and better service or amenities. When Canadians are making their decisions about where to shop, they will therefore weigh these fixed benefits and costs, as well as consider the effects of the real exchange rate.

Let's assume the changes in the Canadian retail market have made the shopping experience in Canada competitive enough with that of the United States that the fixed benefit of shopping in the US has been substantially decreased. Prior to this change the

fixed cost associated with shopping in the US would influence Canadians to shop at home and the fixed benefit of shopping in the US would influence Canadians to shop there. Consumers could then be thought to be at the margin and swayed to shop in one country or the other by changes in the real exchange rate. After the change in Canadian retail, the fixed costs would still influence people to shop at home, but the fixed benefit influencing people to shop across the border would be less. Now consumers are farther from the margin and based only on fixed costs and benefits would prefer to shop at home; they would need larger fluctuations of the real exchange rate to decide to cross-border shop. Prior to the change in retail the two countries are more differentiated, which is represented by the fixed benefit associated with shopping in the US. When the fixed benefit is combined with the fixed cost, consumers are close to the margin and very responsive to the real exchange rate. After the change in retail the two countries are less differentiated, which is represented by a smaller fixed benefit associated with shopping in the US. When this smaller fixed benefit is combined with an unchanged fixed cost, consumers are farther from the margin and less responsive to changes in the real exchange rate.

Wal-Mart is a very popular example of both the success of big-box style retailing and the entrance of American retailers into the Canadian marketplace and can be used to get an idea of when the changes in the Canadian retail market began. Wal-Mart Canada started by buying 122 Woolco Canada stores in 1994 and now operates 317 retail stores and employs over 75,000 associates. Wal-Mart has affected the Canadian economy through the low prices that are offered to consumers, as well as the relationship that exists with suppliers. Wal-Mart works with over 6,000 Canadian suppliers and pays over $11

billion per year for the inputs. (All of this information is from the Canada fact sheet located on the Wal-Mart website.)

VIII. *A Closer Look at Retail*

The Canadian retail market was presented as a potential reason for the changes in cross-border shopping in the previous section. This section will be devoted to analyzing the Canadian retail market and how it has changed. In 2004 Industry Canada's Office of Consumer Affairs released a report on consumer trends and included a section on changing retail markets. In the introduction of this section they state:

> "A number of large non-Canadian-based retailers (mainly from the United States) have established a significant presence in Canada, bringing with them new approaches to doing business, such as use of the "big-box" retail format, everyday low pricing, and electronic data interchange with suppliers. Several Canadian retailers are transforming themselves to compete successfully with these large newcomers, while in some sectors, local independent retailers have disappeared altogether. In the short term, Canadian consumers have benefited from the lower prices and added convenience associated with the changed retail market structure, but, at the same time, the retail market has become more homogenous and concentrated." (Pg. 35)

This succinctly summarizes the changes in the Canadian retail market that have been referred to so far and mentions American retailers entering the Canadian market, which would lead to similar product availability for the two countries. In fact, the report goes on to give the statistics that in 1985 there were 10 American retail chains in Canada and in 2003 there were 185 and that of the top 20 retail chains in Canada with the highest sales 11 were American in 2003.[8]

The popularity of big-box retailers has been growing in North America and while the US has led this trend, Canada is not far behind. In a 1999 article Statistics Canada

[8] The Industry Canada report discusses changing retail markets and incorporates facts from other sources. This statistic was taken from a report prepared for the Office of Consumer Affairs by the Centre for the Study of Commercial Activity (CSCA) (2003).

economist Eric Geneste-Leplante studies the growth of big-box stores in Canada over the period of 1989 to 1997. He uses the size of a store in square feet as the classification criterion and also groups big-box stores into supermarkets, specialized stores and general merchandise stores. He focuses his research on specialized big-box stores and finds that overall the number of big-box stores and their market share of sales increased for that group over the time period considered. In addition to big-box stores being part of the new retail landscape, there are also power centers, which are groupings of big-box stores, and as of 2002 there were 213 in Canada.[9] One advantage of big-box retailers is that they are able to influence suppliers with the large contracts that they offer and their buyer power results in lower prices (Industry Canada, 2004).

Big-box style retailers are successful because of their use of information technology and high productivity, as well as for the convenient shopping experience that they create for their customers. Over the last years there has been an increase in the productivity of the American and Canadian retail trade sectors and stores such as Wal-Mart have been leading the way. To introduce this idea information from an article by Baldwin and Gu (2008) will be presented, which provides some insights into the dynamics of the Canadian retail market. Baldwin and Gu show that entry and exit is the main source of productivity growth in the Canadian retail sector and that it is a sector characterized by high firm turnover. In fact, in their empirical analysis they find that of the firms that were in business in 1984 about 60% were no longer in business in 1998 and that entrants are more productive than firms that exit. Interestingly, foreign-controlled firms were found to be significant contributors to productivity growth and their share of

[9] This statistic is from the Industry Canada report and the Centre for the Study of Commercial Activity (CSCA) is given as the source.

productivity growth was lager than their share of sales over the period analyzed. Baldwin and Gu use this information to explain that the Wal-Mart effect, of an increase in competition leading to an increase in productivity, occurs through the dynamics of firm turnover. Now that we understand how productivity gains in the Canadian retail sector occur, we can see how quickly the market would respond to the increased competitive pressure of highly productive American big-box stores.

Some interesting work has been done on US retail productivity, which will be presented and then related to Canada. In a 2001 report completed by The McKinsley Global Institute (MGI) US productivity growth was analyzed and the analysis of the retail sector concentrated on general merchandising. It was determined that both Wal-Mart, through the spreading of its technological and organizational practices and own high productivity, and the effect of consumers becoming wealthier and substituting to more expensive items were responsible for a noted increase in productivity growth for general merchandising. The impact of Wal-Mart was examined and found to be somewhat different between the two periods considered, which were 1987-1995 and 1995-1999. Between 1987 and 1995 Wal-Mart increased their sales share of general merchandising from 9% to 27% and increased their productivity lead on the rest of the market from 44% to 48%. Between 1995 and 1999 Wal-Mart's productivity lead shrank to 41% and their sales share only increased to 30%, due to other retailers competing more aggressively to stop the trend of Wal-Mart gaining market share. In fact, MGI notes that, Gerald Storch, vice-chairman of Target was quoted in the Economist as saying that Target is the "world's premier student of Wal-Mart."

The staples of Wal-Mart's business plan, which have lead to its success, include the big-box format, everyday low pricing and efficiency in logistics, according to MGI. The advantages of the big-box format are that economies of scale for labor are possible and it allows a store to stock many different products. MGI explains that there is a cycle created with respect to everyday low pricing in which low prices lead to high sales, which lead to scale-created cost savings and buyer power, which lead to lower prices and higher sales again. In terms of efficiency in logistics, Wal-Mart has acted as its own distributer and become more efficient by removing the link of the wholesaler in the supply chain. Wal-Mart has also been a leader in technological advancement and is responsible for the initial adoption of such technologies as scanning using UPC codes and electronic supply chain management tools.

When companies such as Wal-Mart are more productive than their competitors they gain market share and force their competitors to adapt, which leads to a more productive retail market. This effect may have occurred first in the United States and made the shopping experience there better than the shopping experience in Canada, which would explain the high level of responsiveness to the real exchange rate of cross-border shopping over the 1990s. The entry of Wal-Mart into Canada and the effect of increasingly productive retailers would have occurred later in Canada and may have caused the decrease in the responsiveness of cross-border shopping to the real exchange rate in the early 2000s. It appears that retail has been revolutionized by the advent of the big-box format and that this was present in the United States before Canada, which may explain the trends in the relationship between the real exchange rate and Canadian cross-border shopping.

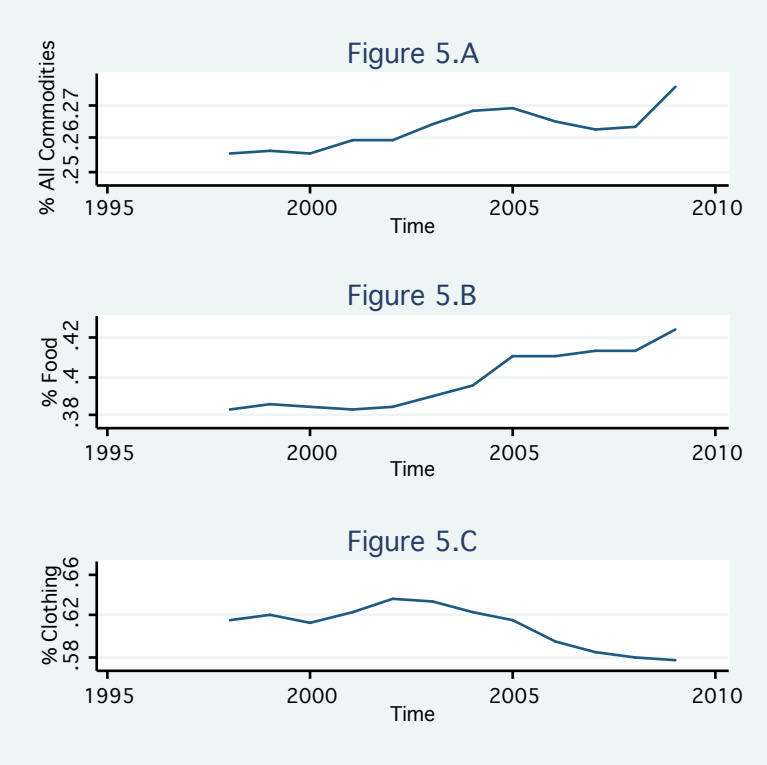
When discussing changes in the retail market the effects on concentration are important. Different sources have reported different concentration results. In the quote from the Consumer Trends Report at the beginning of this section it is stated that the Canadian retail market "has become more homogenous and concentrated." While this may be a natural conclusion some other sources do not support this result. For example, in the article by Wulong and Gu (2008), a Herfindahl concentration index for the retail trade sector is presented for the 1990s that shows concentration declined over this period and the result is linked to increased competition.[10] Wulong and Gu also mention an article by Foster, Haltiwanger and Krizan (2002), which considers US retail productivity growth over the 1990s, and include in their paper a footnote about the concentration findings. Foster, Haltiwanger and Krizan find that the US retail trade sector became more concentrated and estimate that the four-firm concentration ratio increased from 5.2% in 1987 to 6.8% in 1992 and increased again in 1997. It is difficult to make any conclusive statements about the level of concentration in the Canadian retail market in the 1990s and 2000s, however it is possible that some retail sectors are experiencing increases in the level of concentration and others are experiencing decreases. Later in the Consumer Trends Report some statistics using the four-firm concentration ratio are given.[11] It is reported that between 1998 and 2001 the market concentration for general merchandising, prescription drugs and food, the most concentrated retail sectors, increased and the market concentration for household furnishings and appliances and apparel, the least concentrated retail sectors, decreased.

[10] Note that the Herfindahl concentration index is the sum of the squared market share of all firms and the concentration ratio is the sum of the market shares of the four largest firms.
[11] The Industry Canada report presents and discusses these statistics and lists Gomez-Insausti 2000 and CSCA 2003 as the source.

As a final note, a measure of the percentage of big-box type retailers in the Canadian marketplace is now presented. A combination of the method suggested by Stats Link Canada and the data available through Statistics Canada is used. In their section on market research for Canadian retail sales, Stats Link Canada recommends using Statistics Canada's Quarterly Retail Commodity Survey and Monthly Survey of Large Retailers to determine the market share of large retailers. The Quarterly Retail Commodity Survey provides data for the total retail sales of a given commodity and The Monthly Survey of Large Retailers provides data for the retail sales of a given commodity by large retailers. The latter survey collects data from a panel of about 80 of the largest retailers in Canada selling goods such as food, clothing, home furnishings, electronics, sporting goods and general merchandise. One can access a list of the retailers included and some of the most well known are Loblaws, Sobeys, Hudson's Bay Company, Sears Inc, Wal-Mart Canada Corp, American Eagle Outfitters Canada Corporation, Best Buy Canada Ltd, Canadian Tire Corporation, Costco Wholesale Corp, Foot Locker Canada Corporation, Gap (Canada) Inc, Ikea Canada Limited Partnership, Old Navy (Canada) Inc, Roots Canada Ltd, Sony of Canada Ltd, and Winners Merchants International LP. The same commodity groups exist for both the Quarterly Retail Commodity Survey and the Monthly Survey of Large Retailers, so for a given commodity group one can divide the retail sales of the latter by the retail sales of the former to determine the market share of large retailers. One can then complete this process for a series of years to determine whether large retailers are gaining or losing market share.

Annual data for 1998 to 2009 is used to calculate the percentage of retail sales by large retailers for all commodities, food and beverage and clothing and accessories. The graphs are presented below in Figure 5. It can be seen that the market share of large retailers increased over the period 1998-2009 for all commodities and food and beverage and decreased for clothing and accessories.

Figure 5



IX. *Conclusions and Future Research*

This paper has analyzed the changes in cross-border shopping that have occurred over the past three decades. A structural change model was used and the Chow Test and Quandt Likelihood Ratio Test were used to estimate the location of structural breaks. National data on cross-border shopping was disaggregated and used to analyze the

changes for the 8 provinces of Canada possessing a land border with the United States. In addition, real exchange rates for food and for clothing were used to determine how the changes affected different retail groups. It was found that there was a change in the relationship between Canadian cross-border shopping and the real exchange rate and the structural break was estimated to have occurred in October 2001 when the data on national border crossings and the real exchange rate for all items was used.

Some potential explanations for the changes in Canadian cross-border shopping were also presented. The terrorist attacks of September 11th and their possible effects on cross-border shopping were discussed, as were the changes in the Canadian retail market.

Future research could focus on modeling cross-border shopping over the entire period from the early 1970s to the present using more explanatory variables. This analysis uses the real exchange rate as the independent variable, but the income of Canadians and price differentials for specific commodities could also be included. Another direction for future research could be to include retail data in the regressions on cross-border shopping to evaluate empirically the explanation of changes in the Canadian retail market. Future research could also analyze cross-border trips of a longer duration and compare results to those obtained for same-day trips. (Refer to the Appendix for graphs of trips of different lengths.)

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X. *Appendix*

X.1 *Variables*

A complete list of the variables used in the analysis is presented below.

Cars = the number of automobiles returning to Canada in the same day
CarsUS = the number of automobiles returning to the US in the same day

CarsBC = the number of automobiles returning to British Columbia in the same day
CarsAB = the number of automobiles returning to Alberta in the same day
CarsSK = the number of automobiles returning to Saskatewan in the same day
CarsMB = the number of automobiles returning to Manitoba in the same day
CarsON = the number of automobiles returning to Ontario in the same day
CarsQC = the number of automobiles returning to Quebec in the same day
CarsNB = the number of automobiles returning to New Brunswick in the same day
CarsYT = the number of automobiles returning to the Yukon in the same day

USRate = the nominal exchange rate in US dollars
CANRate = the nominal exchange rate in CDN dollars

CANCPI = the CPI for Canada using all items
USCPI = the CPI for the US using all items

USReal = USRate * CANCPI/USCPI = the real exchange rate in US dollars
CANReal = CANRate * USCPI/CANCPI = the real exchange rate in CDN dollars

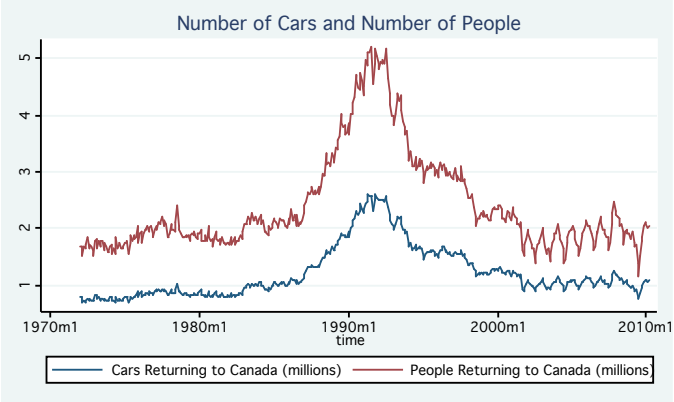
The CPIs for each of the eight regions of Canada considered are used in place of the national CPI to construct real exchange rates for the provinces.

CANCPIApp = the CPI for Canada using apparel items
USCPIApp = the CPI for the US using apparel items
CANCPIFood = the CPI for Canada using food items
USCPIFood = the CPI for the US using food items

The CPIs for the retail group are used in place of the CPIs for all items in the calculation of retail group specific real exchange rates.

X.2 *Number of People Returning to Canada in the Same Day by Automobile*

An alternative way to measure cross-border trips is by the number of people returning to Canada in the same day by automobile, instead of the number of automobiles returning to Canada. The two series are very similar and their correlation is 0.9813 for the seasonally adjusted series (presented below) and 0.9765 for the regular series. For this reason considering only the number of car trips should be sufficient. For completeness, a graph of the two series and some summary statistics are included below.

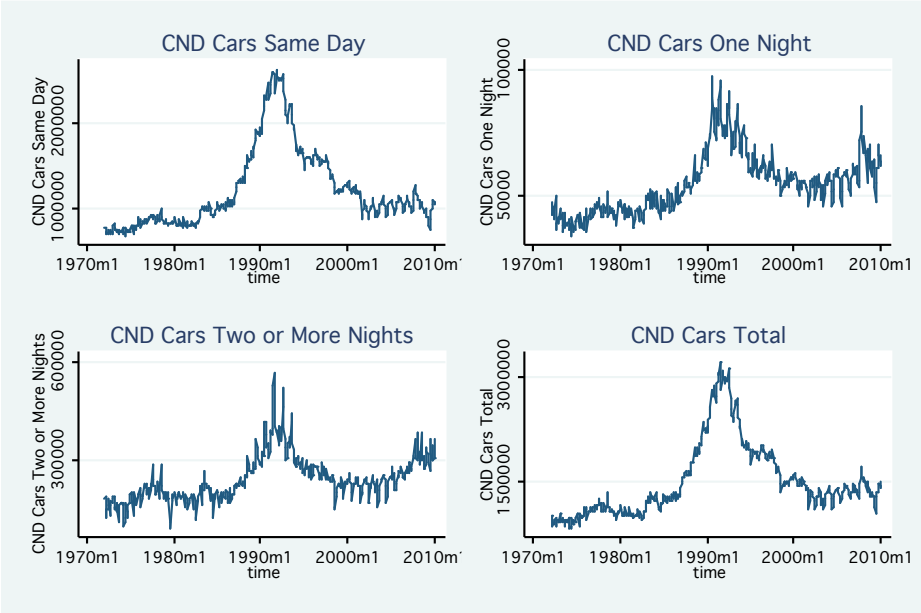


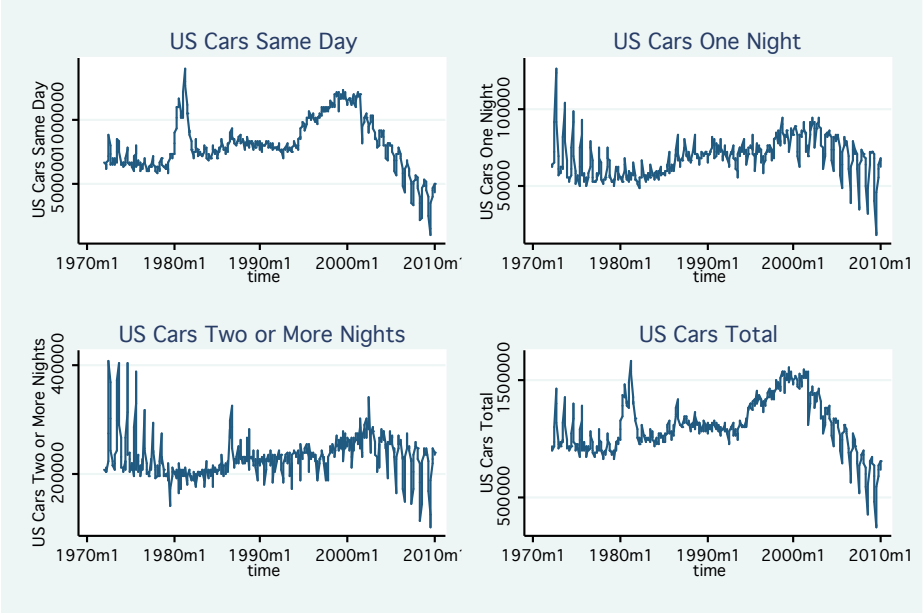
Variable	Obs	Mean	Std. Dev.	Min	Max
Cars	459	1218050	479399.7	563035	2812170
People	459	2408182	949684.6	1153423	5875152

The seasonally adjusted cars series are used for the graphs presented in the text and Appendix. The unadjusted cars series are used for the summary statistics presented in the text and Appendix so that true maximums and minimums can be noted. Everywhere else the seasonally adjusted cars series are used.

X.3 *Number of Return Trips for Different Lengths of Stay*

Data is also available on the number of return trips by automobile for trips lasting one night and two or more nights and for trips of all durations. Presented below are graphs for both Canada and the United States and some summary statistics.



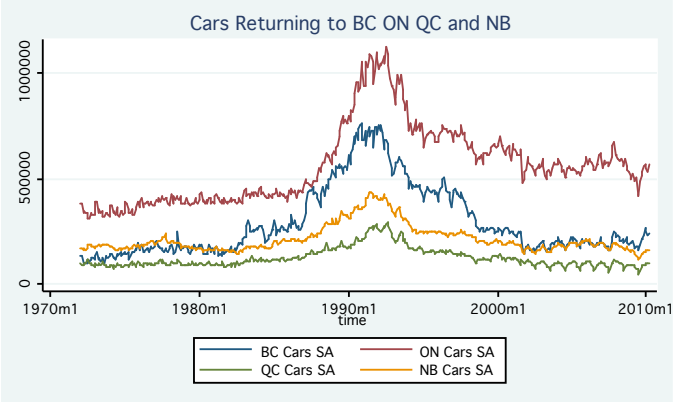


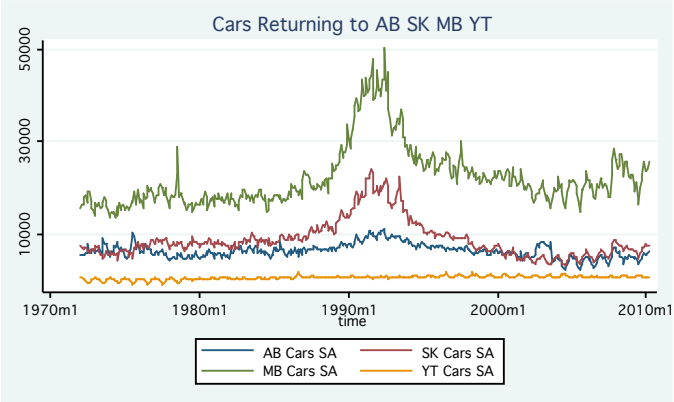
Variable	Obs	Mean	Std Dev	Min	Max
Cars (CND) (Same Day)	459	1218050	479399.7	563035	2812170
Cars (CND) (One Night)	459	55068.86	20509.62	21649	131109
Cars (CND) (Two Nights)	459	242590	120592.9	56895	778640
Cars (CND) (Total)	459	1515709	580271.2	641579	3674827

Variable	Obs	Mean	Std Dev	Min	Max
Cars (US) (Same Day)	459	812006.1	268255.1	303123	1574567
Cars (US) (One Night)	459	67881.07	32510.71	20595	183409
Cars (US) (Two)	459	230160.6	154024.9	47000	698998
Cars (US) (Total)	459	1110048	418378.5	429035	2279479

X.4 *Provincial Data*

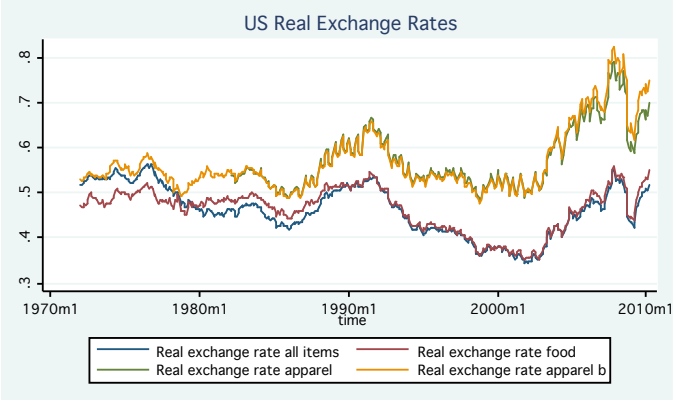
Below are graphs of the number of same day return trips for each of the eight regions considered. The first includes the four regions with the largest volume of cross-border trips: British Columbia, Ontario, Quebec and New Brunswick. The second includes the four regions with the smallest volume of cross-border trips: Alberta, Saskatewan, Manitoba and the Yukon.





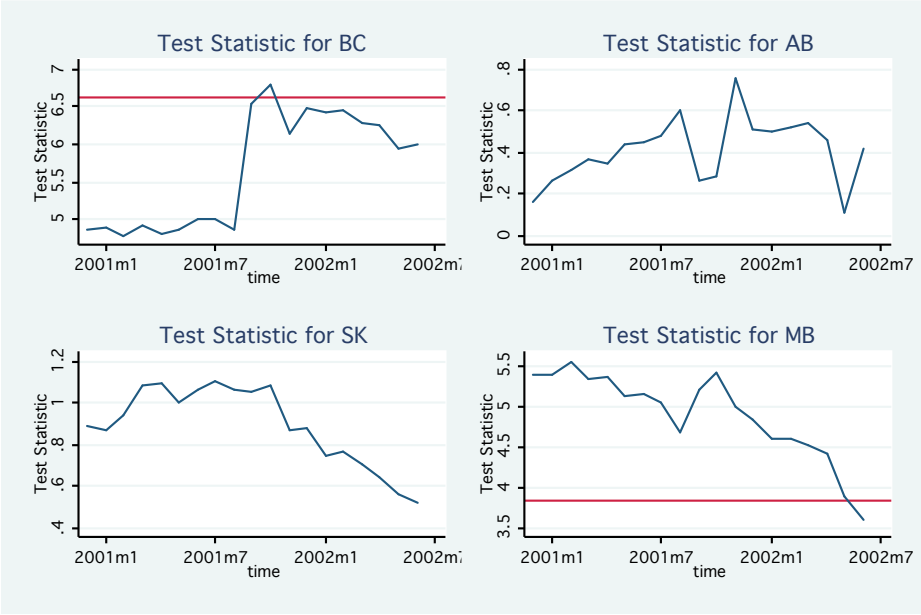
X.5 *Real Exchange Rate Data*

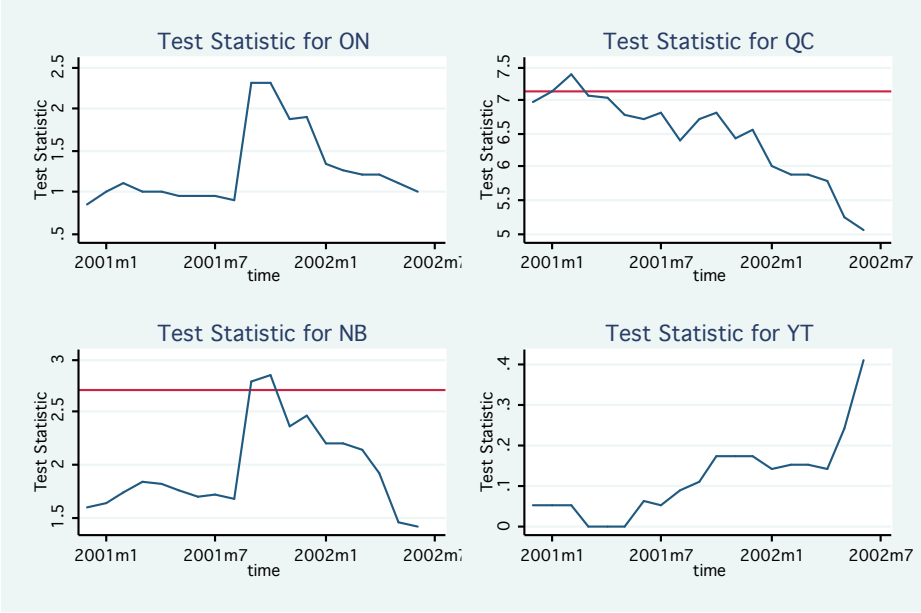
Below is information on the real exchange rate data. A graph is presented of the different measures of the US real exchange rate, including the real exchange rate for all items, the real exchange rate for food items and the real exchange rate for apparel items. Two measures of the real exchange rate for apparel items are included because the Canadian CPI data for clothing items only goes back to 1982m3, whereas the data for clothing and footwear extends past the beginning of the dataset. The second series is labeled b. A table of summary statistics is also included.



Variable	Obs	Mean	Std Dev	Min	Max
RER (US $) (All)	459	0.4611	0.0551	0.3441	0.5639
RER (US $) (Food)	459	0.4632	0.0484	0.3507	0.5579
RER (US $) (Apparel)	337	0.5754	0.0681	0.4817	0.7891
RER (US $) (Apparel b)	459	0.5688	0.0701	0.4778	0.8224

X.6 *Test Statistics for Provinces*





X.6 *Test Statistics for Real Exchange Rates*