1-2015

Drug Violence, the Peso, and Northern Border Retail Activity in Mexico

Thomas M. Fullerton Jr.
University of Texas at El Paso, tomf@utep.edu

Adam G. Walke
University of Texas at El Paso, agwalke@utep.edu

Comments:
Technical Report TX15-1
A revised version of this study is forthcoming in *Annals of Regional Science*, doi: 10.1007/s00168-014-0636-y

The University of Texas at El Paso

UTEP Border Region Modeling Project

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Produced by University Communications, January 2015

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This technical report is a publication of the Border Region Modeling Project and the Department of Economics & Finance at the University of Texas at El Paso. For additional Border Region information, please visit the www.academics.utep.edu/border section of the UTEP web site.

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UTEP Border Region Econometric Modeling Project

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Special thanks are given to the corporate and institutional sponsors of the UTEP Border Region Econometric Modeling Project. In particular, El Paso Water Utilities, Hunt Communities, and The University of Texas at El Paso have invested substantial time, effort, and financial resources in making this research project possible.

Continued maintenance and expansion of the UTEP business modeling system requires ongoing financial support. For information on potential means for supporting this research effort, please contact Border Region Modeling Project - CBA 236, Department of Economics & Finance, 500 West University, El Paso, TX 79968-0543.

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Thomas M. Fullerton, Jr.
Adam G. Walke
Department of Economics & Finance
University of Texas at El Paso
500 West University Avenue
El Paso, TX 79968-0543
Telephone: (915) 747-7747
Facsimile: (915) 747-6282
Email: tomf@utep.edu

*A revised version of this study is forthcoming in ***Annals of Regional Science***, doi: 10.1007/s00168-014-0636-y

Abstract

Exchange rate fluctuations and international business cycles may acutely affect retail sales in border regions where residents have the option of shopping in the neighboring country. This study examines the determinants of retail sales in six cities located along Mexico's northern border. Retail activity in these cities is found to increase in tandem with real depreciations of the peso, lower unemployment rates in neighboring US counties, and increased border crossings. Taken together, these results suggest that cross-border shopping contributes to retail activity in the northern border region of Mexico. The opportunities for cross-border shopping may also condition the impact of violent crime on border-region retail sales. In recent years northern Mexico has been deeply affected by a crime wave associated with competition among drug cartels. Homicides related to organized crime are found to have a statistically significant negative impact on retail sales. A surge in crime levels may stifle retail activity in affected areas as extortion and attacks force some stores to close or reduce operating schedules at the same time that some potential customers elect to shop in relatively safer districts across the international divide.

Keywords

US-Mexico border, retail activity, crime, exchange rates

JEL Codes:
R12, Regional Economic Activity; F31, Foreign Exchange; F44, International Business Cycles; K42, Illegal Behavior.

Acknowledgements

Financial support for this research was provided by Hunt Communities, El Paso Water Utilities, JPMorgan Chase Bank of El Paso, Texas Department of Transportation, UTEP Center for the Study of Western Hemispheric Trade, Hunt Institute for Global Competitiveness, and a UTEP College of Business Administration Faculty Research Grant. Econometric research assistance was provided by Carlos Morales, Pedro Niño, and Francisco Pallares.

Introduction

Retail markets that span international boundaries are distinct from those that lie wholly within single countries in a variety of ways. In border regions, both consumers and retailers are uniquely positioned to exploit price differentials between countries. However, location near a border also entails economic risks such as a high degree of exposure to downturns in the neighboring country's business cycle and reductions in the value of its currency. That is because changes in the incomes and purchasing power of shoppers on one side of the border often impact the sales of retail outlets

on the other side (Clark 1994; Fullerton 2001). Another potential determinant of retail activity that may likewise be conditioned by the presence of an international boundary is violent crime. A high incidence of violent crime on one side of the border may affect the configuration of retail activity by redirecting the flow of cross-border shoppers towards areas that are perceived as safer.

The US-Mexico border zone offers an opportunity to study these dynamics. A total of 61 million personal vehicle crossings and 40 million pedestrian crossings were recorded at ports of entry along the border in 2011 (BTS 2012). Not surprisingly, foreign visitors are important to regional economies on both sides of the boundary. Surveys conducted on different segments of the border suggest that between 42 and 85 per cent of Mexican visitors to the United States cross the border to shop (Ghaddar and Brown 2005). A study of the San Diego-Tijuana region indicates that US citizens account for approximately 29 percent of border crossings and shopping is the purpose of many of these visits (SDD 1994). The effects of cross-border shopping on retail activity north of the border are well documented (Adkisson and Zimmerman 2004; Coronado and Phillips 2007). One goal of this analysis is to examine the relatively unexplored relationship between border crossings and retail activity in northern Mexico.

Unfortunately, the northern border states of Mexico have witnessed an unprecedented wave of violent crime in recent years as rival factions fight to control the sale of contraband narcotics into the United States. These states experienced a nine-fold increase in homicides related to organized crime between 2007 and 2010 (PR 2012). According to a 2010 survey, 68 percent of businesses in northern Mexico have been touched by organized crime (BM 2011). Greenbaum and Tita (2004) argue that, while variations in the average levels of violent crime from one area to another are unlikely to affect retail sales, a large-scale crime wave can exert a substantially negative impact on the retail sector. In cities like Ciudad Juárez that have been ravaged by crime wave in recent years, the combination of extortion by criminal rackets and reduced cross-border shopping by Americans has reportedly taken a heavy toll on retailers (EM 2011). In evaluating the potential benefits of initiatives designed to combat criminal networks in northern Mexico, it is important to take into account the impacts of organized crime on metropolitan retail activity.

This section is followed by a review of the literature regarding retail sales, cross-border shopping, and crime. The subsequent section discusses the sources of data for this study and the analytical framework employed. Empirical results are then presented, along with a conclusion.

Literature Review

A number of the factors that affect cross-sectional variations in retail activity are already well documented. Differences in population and per capita income across US urban areas are directly related to differences in retail sales (Liu 1970). Ingene and Yu (1981) find that the average household size and population density in a given metropolitan area positively impact the level of retail sales. The level of car-ownership and the unemployment rate are also found to affect retail sales, but the signs of their respective marginal effects vary depending on the specific sub-sector being examined. Demographic variables are used less frequently in time series models of retail sales, but changes in personal income are found to impact sales over time in a single geographic area (Schmidt 1979; Geurts and Kelly 1986).

While variables such as income seem to impact retail activity regardless of location, factors unique to border regions are the main focus of this analysis. Proximity to an international boundary creates unique opportunities for retailers and shoppers. Prices may vary substantially between neighboring countries (Engel and Rogers 1996; Morshed 2011), and such price differentials are brought into

sharp relief at national borders. Residents of the immediate border zone can take advantage of lower prices by crossing the border to shop (Clark 1994). Differing tax regimes between countries incentivize cross-border shopping for products such as gasoline (Banfi et al. 2005) and cigarettes (Ben Lakhdar 2008) in some European countries. Many Texas border region residents cross the border into Mexico in search of lower prices for medications and medical services (Fullerton and Miranda 2011; Baruca and Zolfagharian 2012).

Changing economic conditions in neighboring countries often shift the volume and direction of cross-border shopping flows. Gerber and Patrick (2001) find that changes in Mexico's gross domestic product have a positive and statistically significant impact on retail sales in two Texas counties that border Mexico. Similarly, an increase in Canadian real wages and salaries stimulates same day shopping trips to the United States (Di Matteo and Di Matteo 1996). Exchange rate fluctuations can also impact cross-border commerce. A real depreciation of the US dollar tends to increase the number of gasoline and food establishments in counties bordering Canada as more Canadians cross the border to shop (Campbell and Lapham 2004). Likewise, an appreciation of the dollar relative to the peso tends to reduce retail sales in US cities and counties that border Mexico (Patrick and Renforth 1996; Gerber 1999; Fullerton 2001).

A shift in the real exchange rate may have other consequences on border economies besides affecting cross-border shopping. This is especially true in northern Mexico where proximity to US consumers and relatively low wages attract factories that produce goods for export (Sargent and Matthews 2004). In this area, a depreciation of the peso may stimulate employment by reducing dollar-denominated wages (Coronado et al. 2004; Cañas et al. 2007), although Varella-Mollick (2009) presents evidence to the contrary. Studies of Asian economies also suggest that an appreciation of the domestic currency can reduce manufacturing employment (Hua 2007) and the output of tradable goods (Daquila 1989). If the exchange rate influences retail sales, this could be due to changes in local employment as well as, or instead of, variations in cross-border shopping.

Just as differences in relative prices, income levels, and regulatory structures contribute to legal cross-border commerce, such factors can also encourage illicit trade (Moré 2011). Galeotti (1995) documents that supply imbalances in the republics of the former Soviet Union and surrounding countries contributed to an increase in organized crime and smuggling across porous borders in the region. Ceccato and Haining (2004) find that the construction of an international bridge between cities in Denmark and Sweden coincided with an increase in human smuggling and vehicle theft, although most forms of crime were unaffected. It is suggested that cross-border drug smuggling could have the side-effect of increasing burglary and theft.

While much of the economic literature on crime centers on determinants of crime, a growing body of research focuses on the consequences of criminal activity. Greenbaum and Tita (2004) find that a surge in the number of homicides in a given neighborhood adversely affects retail businesses. By contrast, Rosenthal and Ross (2010) find a positive relationship between a neighborhood's level of violent crime and its level of retail activity. However, the share of retail activity relative to wholesale activity is negatively related to violent crime rates, suggesting that retailers are more sensitive than wholesalers to violent crime. While these studies examine how violent crimes may affect retail activity at the neighborhood level, it is unclear whether there are situations in which such crimes inflict impacts on retail sales at the municipal level.

Some research indicates that the economic impacts of violence may be especially acute for regions that rely heavily on international tourism. Safety is an

important factor in evaluating tourist destinations (Yüksel and Yüksel 2007), and a surge in violence may divert tourist traffic to regions perceived as safer. In a study of countries in the eastern Mediterranean region, Drakos and Kutan (2003) find that a nation's share of the total tourism market is negatively impacted by incidents of terrorism. Greenbaum and Hultquist (2006) report evidence that foreign tourists are more sensitive that domestic visitors to acts of terrorism in Italy. These studies have implications for the US-Mexico border region, where cross-border tourism plays an important role in regional development.

Besides driving away potential customers, crime may also impact retailers directly. Direct impacts of crime include activities such as extortion, arson, and robbery perpetrated against businesses. Daniele and Marani (2011) use reported incidents of extortion, bomb attacks, arson, and crimes of criminal association to construct an index of organized crime and find that this index is negatively correlated with inflows of foreign direct investment in Italian regions. In discerning the impact of crime on retail sales, both direct threats to businesses and threats to their clientele should be considered.

A variety of statistical techniques have been used to analyze retail sales. autoregressive integrated moving average (ARIMA) models are sometimes useful in studying retail sales over time because such series often move in predictable patterns (Holder and Wagenaar 1990). It is also possible to analyze retail sales using transfer function models, which combine aspects of ARIMA and structural econometric models (Trívez and Mur 1999). As described in the subsequent section, the analysis is conducted using a transfer function modeling approach. Both the seasonal patterns inherent in most retail sales series and the socio-economic forces acting upon retail activity can be modeled using this approach.

Data and Methodology

The sample includes all cities along the northern border of Mexico with populations above 250,000: Tijuana, Mexicali, Ciudad Juárez, Nuevo Laredo, Reynosa, and Matamoros (see Figure 1). This group of urban areas constitutes 79 percent of the population of Mexico's northern border municipalities (Instituto Nacional de Estadística y Geografía [INEGI] 2010). The cities are situated a short distance from economically important border cities in the United States and the ports of entry located nearby account for a majority of the traffic across the international divide (Hanson 1996; BTS 2012). One quarter of the drug-related homicides committed nationwide between 2007 and 2010 occurred in these six cities (PR 2012). Also relevant for a study of cross-border economic linkages is the fact that more than a quarter of total national employment in the export-oriented manufacturing sector is concentrated in these cities (INEGI 2012).

Fig. 1 Map of Major Northern Mexico Border Cities included in Sample

The government statistics agency in Mexico, INEGI, does not issue information to the general public on the monetary value of retail sales, but it does publish monthly-frequency real retail sales indices based on 2003 prices (INEGI 2012). The indices for each urban area are the dependent variables in this analysis. Although retail stores constituted 44 percent of all businesses in the six border cities studied in 2008, they had only 3.9 employees on average, compared with 10.2 workers per business across all economic sectors (INEGI 2009). Small businesses have traditionally dominated most sectors of Mexico's retail industry (Moreno-Pérez and Villalobos-Magaña 2010). While larger businesses may be able to partially insulate themselves from the risk of extortion by organized crime rings, this is more difficult for small businesses (EM 2011).

The variables used in the analysis are defined in Table 1. Wages and the industrial production index are included to account for the impacts of local and national business cycle fluctuations on retail sales (Ingene and Yu 1981; Geurts and Kelly, 1986). A measure of cross-border business cycles, the unemployment rate in neighboring US counties, together with the real exchange rate index, are incorporated because similar variables have been found to impact retail activity in border economies (Gerber and Patrick 2001). The number of border crossings is added as a measure of cross-border tourism that is likely to be inversely related to the intensity of border security and delays in crossing the border (Fullerton 2007). Finally, organized crime-related homicides are included because they may discourage shopping (Greenbaum and Tita 2004) and may sometimes result from punitive attacks on businesses related to extortion (Daniele and Marani 2011).

Table 1: Variables

Variable Names	Definitions	Units of Measure
Retail Sales Index	An index of net retail sales in real terms (2003 = 100)	Index points
Real Hourly Wage	Total wages paid to staff in export-oriented manufacturing (IMMEX) firms divided by total hours worked in those firms and by nationwide CPI (December 2010 = 100)	Real pesos per hour
Industrial Production Index	An index of activity in the mining, manufacturing, construction and utilities industries (2003 = 100)	Index points
Real Exchange Rate Index	Inflation-adjusted peso/dollar exchange rate index (March 1997 = 100)	Index points
Cross-Border Unemployment	Unemployment rate in adjacent US counties	Percentages
Vehicle Crossings	Total number of personal vehicle crossings through ports of entry	Vehicles
Pedestrian Crossings	Total number of pedestrian crossings through ports of entry	Pedestrians
Drug-Related Homicides	Deaths resulting from armed clashes or 'execution-style' killings by or against members of an organized criminal network	Deaths

Aggregate income data are not available at the municipal level, but wages of workers in the export-oriented manufacturing sector are available beginning in July of 2007. In 2008, the manufacturing sector represented 48 percent of total employment in the six cities included in this study (INEGI 2009). The performance of the export-processing sector can serve as a bellwether for trends affecting metropolitan economies in northern Mexico. In Ciudad Juárez, for example, it affects variables such as total population (Fullerton and Barraza de Anda 2008) and bridge crossings (De Leon et al. 2009). The real hourly wage in the export-processing sector is equal to total wages divided by the total number of hours worked and the consumer price index. These variables as well as Mexico's industrial production index are retrieved from the website of INEGI (2012).

The real exchange rate index utilized is from the Border Region Modeling Project at the University of Texas at El Paso (UTEP 2012). A rise in this index reflects a real depreciation of the Mexican peso relative to the US dollar. The Bureau of Labor Statistics provides data on the unemployment rates of counties located immediately adjacent to the cities of interest, namely San Diego and Imperial counties in California and El Paso, Webb, Hidalgo, and Cameron counties in Texas (BLS 2012).

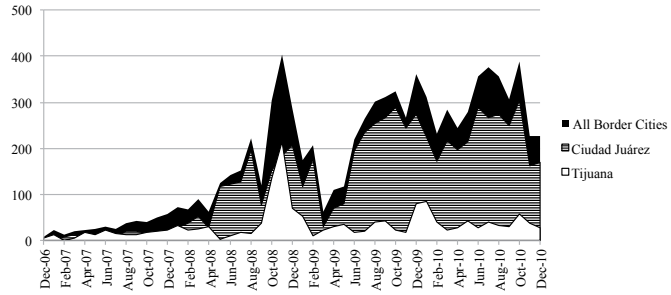
Pedestrian and personal vehicle border crossing/entry data are from the Bureau of Transportation Statistics (BTS 2012). The observation for pedestrian crossings at the Calexico Port of Entry in July, 2008, is missing. Since Calexico pedestrian crossings are correlated with pedestrian crossings at the San Ysidro Port of Entry, this series is used

to estimate the missing observation (Friedman 1962; Fernandez 1981). Chart 1 shows the border crossing data aggregated across all ports of entry included in this study. There is a clear downward trend in personal vehicle crossings after late 2008, which roughly coincides with the rise of drug-related violence and the deterioration of economic conditions in the area.

Chart 1: Border Crossings

The number of homicides related to organized crime is obtained from the presidential website (PR 2012). The data include several types of homicides: those stemming from clashes involving rival criminal groups; those resulting from attacks by such groups on law enforcement agents or other public servants, and those classified as 'execution-style' killings committed by or against suspected members of an organized criminal network. A high degree of brutality and public visibility is a distinctive feature of organized crime-related homicides, which are often calculated to intimidate rivals and the public at large (Molzahn et al. 2013). Chart 2 shows the dramatic rise in border area drug-related homicides since 2008 and it also indicates that the largest cities in the sample, Tijuana and Ciudad Juárez, account for the majority of these murders. The sample period is constrained on the lower end by the manufacturing wage data, which begin in July 2007 and at the upper end by the drug-related homicide data, which end in December 2010.

Chart 2: Border City Homicides Related to Organized Crime



Statistical traits of each variable are described in Table 2. The effects of the 2007-2009 business cycle downturn are reflected in the mean unemployment figures for US border counties, which range from 7.2 percent in Webb County, Texas, to 25.8 percent in Imperial County, California. The latter figure was among the highest in the US during the recession (EM 2009). The ratio of vehicle crossings to pedestrian crossings ranges from nearly 3:1 in Reynosa to less than 3:2 in Nuevo Laredo. There is also considerable variation in the number of drug-related homicides, both between cities and over time within individual cities. While some cities had higher 'baseline' levels of violence than others, they all experienced at least one major surge in homicides during the sample period.

Table 2: Summary Statistics for 42 Month Period, July 2007 to December 2010

Variable	Mean	Standard Deviation	Minimum	Maximum
Tijuana				
Retail Sales	139.5	9.3	122.8	168.6
Hourly Wage	41.5	3.5	37.4	54.4
Unemployment [a]	8.1	2.4	4.8	10.9
Vehicle Crossings	1,503,844	105,048	1,280,561	1,788,993
Pedestrian Crossings	738,821	88,214	582,776	1,038,508
Homicides	37.8	36.8	4	215
Mexicali				
Retail Sales	134.9	11.2	118.3	166.5
Hourly Wage	44.4	2.9	40.8	53.9
Unemployment [a]	25.8	4.5	17.4	32.8
Vehicle Crossings	655,672	72,264	529,507	793,758
Pedestrian Crossings	379,315	50,897	295,859	486,128
Homicides	2.9	2.5	0	9
Ciudad Juárez				
Retail Sales	123.7	7.8	109.3	142.7
Hourly Wage	37.8	1.7	34.8	43.6
Unemployment [a]	7.9	1.7	5.2	10.2
Vehicle Crossings	978,113	155,889	759,456	1,291,673
Pedestrian Crossings	647,080	78,808	524,336	856,928
Homicides	152.3	95.8	9	304
Nuevo Laredo				
Retail Sales	115.1	7.3	103.2	136.0
Hourly Wage	47.1	3.2	41.4	55.9
Unemployment [a]	7.2	1.9	4.3	9.7
Vehicle Crossings	458,246	54,307	356,674	584,080
Pedestrian Crossings	331,540	54,930	218,778	441,399
Homicides	3.5	6.0	0	32

Reynosa				
Retail Sales	159.5	11.9	138.1	185.8
Hourly Wage	35.1	3.0	31.4	46.9
Unemployment [a]	9.4	2.3	5.7	12.7
Vehicle Crossings	528,009	58,718	427,289	639,374
Pedestrian Crossings	185,795	24,519	148,206	260,940
Homicides	5.4	6.3	0	30
Matamoros				
Retail Sales	116.5	9.4	96.9	138.4
Hourly Wage	35.9	3.3	31.7	46.0
Unemployment [a]	8.8	2.2	5.4	11.8
Vehicle Crossings	475,143	71,176	341,053	586,788
Pedestrian Crossings	215,209	21,096	171,290	276,682
Homicides	3.0	3.9	0	15
Non-Local Data				
Ind. Prod. Index	111.9	5.3	99.1	121.0
Exch. Rate Index	97.5	7.5	85.2	115.1

a. Unemployment rates are for US counties immediately adjacent to each city.

The hypothesized relationships between retail sales and each of the explanatory variables are shown in Equation 1. As discussed above, a substantial body of literature indicates that changes in income have direct impacts on retail sales. The industrial production index, which is especially pertinent to the large manufacturing sectors in Mexican border cities, is also expected to be positively correlated with commercial activity. An increase in border crossings, whether by pedestrians or vehicles, may increase retail sales if those upswings in cross-border traffic include customers headed to stores and restaurants located in Mexico. Higher unemployment levels across the border in the United States will be associated with reduced regional prosperity and likely reduce retail sales on both sides of boundary.

$$(1)\quad \frac{\partial\, Sales}{\partial\, Hourly\, Wages} > 0,\ \frac{\partial\, Sales}{\partial\, Industrial\, Production} > 0,\ \frac{\partial\, Sales}{\partial\, Border\, Crossings} > 0,\ \frac{\partial\, Sales}{\partial\, Exchange\, Rate} > 0,\ \frac{\partial\, Sales}{\partial\, Cross - Border\, Unemployment} < 0,\ \frac{\partial\, Sales}{\partial\, Homicides} < 0$$

Peso depreciations reduce the purchasing power of Mexican consumers and encourage those shoppers to purchase more items on the south side of the border. Peso depreciations also tend to increase export-processing employment and to encourage cross-border shopping by US residents. Consequently, peso depreciations are expected to stimulate retail sales. Because the real exchange rate index is defined as pesos per dollar, in inflation adjusted terms, an increase in this index is predicted to cause an increase in retail activity. Increases in drug-related violence, as proxied by the number

of homicides associated with organized crime, are expected to discourage cross-border visitors from the United States from entering Mexico for shopping or recreational activities. Greater levels of violence and crime are also likely to stimulate greater numbers of cross-border shopping trips by residents of northern Mexico to the comparatively safer shopping centers and malls in neighboring US cities. Higher numbers of homicides are, therefore, predicted to cause declines in retail sales. Even though crime does not often affect overall levels of retail activity at the metropolitan level (Rosenthal and Ross 2010), it may negatively impact commerce in border cities due to the opportunities for safer shopping in neighboring countries.

The empirical analysis is conducted using a linear transfer function (LTF) approach (Trívez and Mur 1999). Retail sales are modeled as a function of explanatory variable lags. Then, autoregressive (AR) and moving average (MA) terms are included to account for any remaining systematic variation in the residual series. Cross correlation functions are used to identify which lags of the explanatory variables to include in the specification (Pindyck and Rubinfeld 1998). The general form of a transfer function ARIMA model that includes two explanatory variables is displayed in Equation 2. The terms $\omega_1(B)/\delta_1(B)$ and $\omega_2(B)/\delta_2(B)$ are known as transfer functions and B is a backshift operator; $\theta(B)$ represents MA terms and $\varphi(B)$ represents AR terms.

$$(2)\quad y_t = c + \frac{\omega_1(B)}{\delta_1(B)}x_t + \frac{\omega_2(B)}{\delta_2(B)}z_t + \frac{\theta(B)}{\varphi(B)}u_t$$

Statistical tests are used to determine which variables are non-stationary in level form. Differencing is frequently required to induce stationarity for economic variables from fast-growing border regions (Coronado et al. 2004). Seasonal and non-seasonal AR and MA terms can be included to account for non-random variations in the disturbance term (Trívez and Mur 1999). Given the diverse characteristics of the six urban areas shown in Table 2, it is important to use an approach that allows parameter estimates and lag structures to vary from one city to another. Separate equations will therefore be estimated for each of the cities.

Empirical Results

All of the variables included in the analysis are logarithmically transformed prior to estimation. Given that step, resulting parameter estimates can be interpreted as elasticities. Many of the variables exhibit long-term upward or downward trends. This can be seen for border crossings and homicides in Charts 1 and 2, respectively. *Q*-statistics indicate that almost all of the variables are non-stationary in level form. The variables are, therefore, differenced once to achieve stationarity. Cross-correlation functions indicate that the initial impact of each explanatory variable on retail sales occurs within five months. Both AR and MA terms are included for each city. Tables 3 and 4 summarize the estimation results for the LTF ARIMA equations.

Table 3: Western Border City Estimation Results for Real Retail Sales Indices

LTF ARIMA Estimates Dependent Variables: Retail Sales Indices		Tijuana		Mexicali		Ciudad Juárez
	Lag	Coefficient (t-statistic)	Lag	Coefficient (t-statistic)	Lag	Coefficient (t-statistic)
Constant	NA	-0.0005	NA	0.007955	NA	0.008026
		(-0.1132)		(2.1003)		(5.5516)
Mfg. Hourly Wage	t-0	0.4348	t-0	0.6246	t-0	0.5589
		(14.1934)		(5.1776)		(4.8759)
Industrial Production	t-2	0.5523	t-2	0.3312	t-2	0.8527
		(5.4378)		(1.4446)		(7.5503)
Exchange Rate	t-3	0.1931	t-3	0.4955	t-2	0.3279
		(1.7188)		(1.8456)		(4.3091)
Cross-Border Unemp.	t-2	-0.0674	t-2	-0.2033	t-1	-0.1870
		(-0.5662)		(-1.2721)		(-2.9818)
Vehicle Crossings	t-0	0.5029	t-0	0.4028	t-0	0.2293
		(3.3908)		(1.4500)		(3.3120)
Pedestrian Crossings	t-0	0.1466	t-0	0.25845	t-0	0.1129
		(1.5334)		(3.0189)		(2.4172)
Homicides	t-1	-0.01657	t-5	-0.03313	t-1	-0.02996
		(-2.0793)		(-4.5142)		(-3.8987)
AR Terms	t-2	0.2866	t-1	-0.3881	t-1	-0.7310
		(1.7642)		(-2.4311)		(-5.4217)
MA Terms	t-12	-0.9250	t-6	-0.8701	t-5	-0.8822
		(-32.2478)		(-10.9558)		(-18.8437)
R-squared		0.965217		0.815707		0.942883
Adjusted R-squared		0.954782		0.769633		0.926301
Log likelihood		110.0051		76.55806		102.8236
F-statistic		92.49842		17.70451		56.86059
Durbin-Watson Stat.		2.015031		2.161626		1.998046
Observations (Months)		40		46		41

Sample Period: July 2007 to December 2010.

Table 4: Eastern Border City Estimation Results for Real Retail Sales Indices

LTF ARIMA Estimates Dependent Variables: Retail Sales Indices		Nuevo Laredo		Reynosa		Matamoros
	Lag	Coefficient (t-statistic)	Lag	Coefficient (t-statistic)	Lag	Coefficient (t-statistic)
Constant	NA	0.003141	NA	0.009272	NA	0.01452
		(1.1231)		(2.6152)		(2.4544)
Mfg. Hourly Wage	t-0	0.6272	t-0	0.3590	t-0	0.2664
		(6.5930)		(1.8576)		(2.0463)
Mfg. Wage (lagged)			t-8	0.3898	t-4	0.3896
				(2.4375)		(3.0545)
Industrial Production	t-2	0.5892	t-2	0.5289	t-2	0.7672
		(2.9635)		(1.4663)		(1.7747)
Exchange Rate	t-5	0.6321	t-4	0.4947	t-4	0.6516
		(2.1741)		(2.2239)		(2.9000)
Cross-Border Unemp.	t-1	-0.1542	t-1	-0.2515	t-2	-0.5361
		(-1.6288)		(-2.2562)		(-2.9285)
Vehicle Crossings	t-0	-0.0352	t-0	0.2943	t-0	-0.1151
		(-0.4413)		(2.1906)		(-0.9153)
Pedestrian Crossings	t-0	0.2206	t-0	-0.05448	t-0	0.5185
		(2.8472)		(-0.4178)		(3.1413)
Homicides	t-1	-0.03521	t-5	-0.02968	t-4	-0.01835
		(-4.7530)		(-2.2222)		(-2.0894)
AR Terms	t-2	-0.4686	t-1	-0.7771	t-1	-0.4104
		(-2.4719)		(-4.3674)		(-1.9677)
MA Terms	t-6	-0.8669	t-6	-0.8769	t-11	-0.8892
		(-16.8118)		(-14.2769)		(-20.9064)
R-squared		0.848273		0.838482		0.893885
Adjusted R-squared		0.802755		0.776359		0.857293
Log likelihood		74.30790		67.10434		84.28763
F-statistic		18.63600		13.49725		24.42873
Durbin-Watson Stat.		2.122949		1.956444		1.892493
Observations (Months)		40		37		40

Sample Period: July 2007 to December 2010.

Changes in hourly manufacturing wages have an immediate positive impact on retail sales. In Reynosa and Matamoros, the immediate effect of a change in wages is relatively small but lagged wages have a strong impact on sales. The contemporaneous wage elasticities of retail sales vary from 0.27 to 0.63 across the six cities. Those figures are comparable to income elasticities of retail sales estimated by Liu (1970) to range from 0.22 and 0.67. In all six urban economies contained in the sample, variations in Mexico's industrial production index have substantial effects on sales after a 60-day lag. This is suggestive of the important role played by industrial activities, and manufacturing in particular, within the economies of Mexican border cities. It also potentially reflects the greater volumes of general economic activity experienced by all major metropolitan economies during business cycle upturns.

Fluctuations of the real exchange rate have a positive impact on retail sales within a range of two to five months. This implies that real depreciations of the peso relative to the dollar are associated with increased retail sales in these northern border cities in Mexico. As discussed in the literature review, such an outcome could result from an increase in cross-border shopping by US residents or from a reduction in dollar-denominated manufacturing wages and the consequent expansion of employment in the export-processing sector. A reduction in the purchasing power of the peso might also deter residents of Mexican cities from crossing the border to shop in the United States (Patrick and Renforth 1996). This could have the effect of temporarily increasing the local retail customer base. Commerce in the larger metropolitan economies of Tijuana and Ciudad Juarez is less impacted by currency market fluctuations than what is observed in the four other cities.

Higher levels of unemployment in the US counties immediately adjacent to the Mexican border cities studied are associated with lower levels of retail sales after lags of between 30 and 60 days. For Tijuana, Mexicali, and Nuevo Laredo, the estimated parameter magnitudes seem plausible, but do not satisfy the 5-percent significance criterion. Just as improved economic conditions in Mexico can boost retail sales in US border areas (Gerber and Patrick 2001), the same dynamic also applies to commercial activity on the south side of the international boundary. The estimated elasticities of retail sales with respect to cross-border unemployment levels vary from –0.07 in Tijuana to –0.54 in Matamoros.

Pedestrian and personal vehicle border crossings are included in the specification to gauge the impact on northern Mexico retailers of cross-border traffic flows. Because most cross-border shopping excursions are day-trips (Di Matteo and Di Matteo 1996), it is not surprising that only contemporaneous lags of vehicle and pedestrian border crossings are included in the specifications shown in Tables 3 and 4. Pedestrian border crossings have a positive and statistically significant impact on retail sales in Mexicali, Ciudad Juárez, Nuevo Laredo, and Matamoros. Vehicle crossings have a similar impact on sales in Tijuana, Ciudad Juárez, and Reynosa. San Diego and McAllen, across the border from Tijuana and Reynosa, respectively, are somewhat removed from the border and many residents of those cities may prefer using personal vehicles to make cross-border shopping trips rather than walking.

It is possible that border crossings are correlated with features of the local economies in border cities that affect retail sales but are not observable and thus form part of the error term. To examine this possibility, an artificial regression test is conducted (Davidson and MacKinnon 1989). Various exogenous variables are collected including local weather conditions, gasoline prices, international bridge tolls, and a proxy for border waiting times, the ratio of insurance and freight costs to the value of imports (Globerman and Storer 2011). These

variables are correlated with border crossings but are not likely to be correlated with the disturbance terms of the retail sales equations. The artificial regression test results indicate that the null hypothesis of exogeneity cannot be rejected.

In all six urban economies included in the sample, homicides related to organized crime are associated with statistically significant negative impacts on retail sales within five months or less. The initial impact of a change in the level of violent crime may be delayed for a matter of months due to uncertainty over the persistence of a crime wave, fixed costs incurred by shopkeepers, and the various logistical considerations involved in adjusting shopping habits. Detotto and Otranto (2010) show that, in Italy, several months may pass before an economic indicator registers the full negative effect of a shock in homicide rates. However, in Tijuana, Ciudad Juárez, and Nuevo Laredo, all of which experienced pronounced levels of violence during the sample period, the negative effects of organized crime-related murders on commerce are observed within 30 days.

The elasticities of retail sales with respect to drug related homicides range between –0.017 and –0.035. Those estimates imply that small numbers of these murders are associated with disproportionately sharp declines in commercial activity. For example, in Ciudad Juárez, an additional two homicides would lead to a retail sales decline of approximately 0.04 percent. Although exact commercial activity and income data are not available for this municipality, the implied loss of direct retail sales is probably $1 million or greater.

Increased levels of violence in Mexican border cities may hamper retail activity by deterring US residents from crossing the border to shop and by encouraging local customers to frequent relatively safer shopping districts in the adjacent US border cities. Some portion of the decline in retail sales may also be due to reduced operating schedules related to fear of organized crime or due to management experience with extortion or attacks. Business or branch office closures may also occur at some locations where heightened physical risks are observed. The latter led to notably high retail vacancy rates in spite of growing border region industrial occupancy rates during the sample period (PREI 2012). Because the vacancies primarily occur among smaller business operations during the crime waves, that means that the bulk of the sales losses are experienced by small retailers who cannot afford protective services and are financially vulnerable.

The results in Tables 3 and 4 confirm conventional wisdom with respect to the impacts of homicides on business conditions in northern border metropolitan economies. An important question is then how to address this public security concern and commercial risk. Recent research (Liu et al. 2012) indicates that a greater police presence reduces homicides across Mexico, including northern border states. Greater public security expenditures involving special tactics forces, equipment, and vehicles will likely help improve retail conditions in these six border cities, but not eliminate the physical risks that accompany organized crime across the region. Increased safety will, however, be required in order to improve business performance in these cities (Rosenthal and Ross 2010).

Conclusion

Retail sector exports play an important role in many border region economies, but have not been extensively documented in the case of the northern border metropolitan areas of Mexico. This paper helps partially fill this gap in the border economics literature. Though the information in Tables 3 and 4 does not permit estimation of the number of US residents who cross the border to shop in Mexico's northern border cities, the estimated coefficients are suggestive of a pronounced cross-border effect on commercial activity in those urban economies.

The combined impacts on retail sales of pedestrian and personal vehicle border crossings, as well as unemployment levels in adjacent US counties, indicate substantial international commercial activity on the south side of the border. The signs of the real exchange rate parameter estimates are also consistent with the hypothesis that US shoppers contribute to retail activity in Mexican border cities, although this coefficient may additionally capture the impact of export-oriented manufacturing employment on retail sales.

This analysis also shows that retail sales in the six largest Mexican border municipalities are sensitive to violence associated with organized crime. While other studies have documented that violent crime can redirect shoppers to safer areas within the same city, the results presented here indicate that whole cities may be impacted by severe crime waves. One potential explanation of this phenomenon is that the presence of twin cities along the US-Mexico border provides shoppers with nearby alternatives to their local security environment. It is also important to recognize that organized criminal networks may affect the supply of retail services by practicing extortion against retailers and using homicide or arson as enforcement mechanisms. In areas afflicted by severe violence, improved levels of public safety will likely help improve commercial activity.

Estimating separate equations for each border city made it possible to analyze differences across cities in the impacts of multiple variables on retail sales. However, this approach also places constraints on the number of cities that can be analyzed in any depth. Future research might involve pooling time series data for cities across Mexico to determine whether the impact of violent crime on retail sales is different in the border region than in the rest of the country. This might shed additional light on the question of how proximity to an international border conditions the impact of violent crime on retail activity.

The data employed in this study are from the six largest northern border metropolitan economies in Mexico. There are smaller border towns such as Nogales, Agua Prieta, Ojinaga, and Piedras Negras that potentially exhibit similar cross-border shopping patterns. The implications from the empirical results discussed above may, consequently, be broader than what the sample utilized otherwise indicates. Additional efforts for the smaller border towns may be of interest, as well.

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Contributors to the book include economic researchers from the University of Texas at El Paso, New Mexico State University, University of Texas Pan American, Texas A&M International University, El Colegio de la Frontera Norte, and the Federal Reserve Bank of Dallas. Their research interests cover a wide range of fields and provide multi-faceted angles from which to examine border economic trends and issues.

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