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El Paso Customs District Cross-Border Trade Flows

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

Richard L. Sprinkle
University of Texas at El Paso
rsprinkl@utep.edu

Roberto Tinajero
University of Texas at El Paso
rtinajero@utep.edu

ABSTRACT

An important issue in applied international economics is the extent to which trade flows adjust to changes in economic activity, relative prices and exchange rates. While there have been numerous studies regarding aggregate trade flows, relatively little empirical work has been completed with respect to analyzing international merchandise trade growth through the United States – Mexico border region. To examine whether border trade flows can be successfully modeled, short-term time series characteristics of cross-border trade flows through El Paso, Texas are analyzed. A transfer function ARIMA econometric methodology is employed using data from January 1995 to December 2002. Empirical results indicate that economic activity in the United States and Mexico along with relative prices adjusted for exchange rate changes play important roles in determining month-to-month fluctuations in border region trade flows.

JEL Category: F15, International Trade; R15, Regional Econometrics

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Introduction

Separated by the occasionally waterless Rio Grande, El Paso and Ciudad Juárez together form one the largest international metropolitan economies in the world. Four bridges, two of which carry commercial trade, connect El Paso and Ciudad Juárez: the more centrally located Bridge of the Americas near Chamizal Park, and the Ysleta-Zaragoza Bridge to the east of both cities. These two bridges clearly provide the primary merchandise trade linkages on the international border with Mexico through United States Customs District 24. In 1994, approximately $17.954 billion in merchandise trade crossed through this border region. By 2002, total trade through this region had grown to approximately $38.449 billion.

Geography, economic growth and trade liberalization have all contributed to the increased volumes of trade between the United States and Mexico. Regional trade flows accelerated subsequent to approval of the North American Free Trade Agreement (NAFTA; see Sullivan, Soden and Conary, 2000). International trade has played and important, if sometimes controversial role in the facilitation of commercial and industrial linkages between the two cities. To understand the dynamic linkages of this unique regional economy requires careful consideration of the role played by international commerce. This paper considers one aspect of this linkage between El Paso and Ciudad Juárez by analyzing monthly trade flows through the El Paso Customs District.

Over the last several decades a large literature has developed concerning the empirical estimation of the demand for imports and exports for developed countries. For example, surveys published by Goldstein and Khan (1985), Stern, Francis, and Schumacher (1976), and Sawyer and Sprinkle (1999) contain more than 100 empirical estimates on the demand for imports and exports by the United States. Given the extensive literature on this subject, a question rises with respect to those aspects of merchandise trade flows that have yet to be documented. To date, the vast majority of the papers on United States foreign trade are concerned with the demand for aggregate imports and exports. There are far fewer papers concerning bilateral trade flows with Mexico (Fullerton, Sawyer and Sprinkle, 1997 and 1999). Empirical analyses of trade flows through regional ports of entries are not very extensive.

Material in this study provides an analysis of the empirical regularities associated with monthly exports and imports of merchandise trade through United States Customs District 24. While there have been a number of studies conducted with respect to the economic ties between El Paso and Ciudad Juárez, the time series behavior of international trade through this port-of-entry has been largely overlooked. To partially address the gap in the literature, a time series econometric methodology is employed as a means for potentially quantifying cross-border trade flows through El Paso. To accomplish that goal, NAFTA-era monthly data from January 1995 to December 2002 are utilized. Subsequent sections of the paper are organized as follows. Section II describes the data and methodology. Empirical results are summarized in the third section. Conclusions and suggestions for future research comprise the final segment of the paper.

Model and Methodology

Modern time series analysis for univariate and small modeling systems dates from 1969 (Pankratz, 1983). The various classes of autoregressive moving average (ARIMA) models have long proven useful in short-term dynamic forecasting applications. These models are also helpful in examining the quantitative consequences of changes in economic variables such as business cycles and exchange rates. The overall flexibility of ARIMA for handling such phenomena, as well as the different data generating processes associated with seasonal variations, has allowed this class of time series models to be applied to a wide range of international and regional economic issues (Trívez and Mur, 1999). Fullerton (1998; 2000) and Fullerton and Tinajero (2002) utilize transfer function methodologies to examine cross-border business cycle fluctuation impacts on commercial electricity sales, exchange rate variations on international commuter flows, and changes in overall economic conditions on northbound cargo vehicle flows from Ciudad Juárez to El Paso. The later study is particularly relevant to the current analysis since it offers at least partial evidence that cross border traffic flows respond fairly quickly to business cycle and exchange rate variations.

The trade flow models utilized to analyze United States imports from and exports to Mexico through the El Paso port-of-entry are quite standard. Economic theory suggests that the quantity demanded of imports (QM) is related to domestic income and/or economic activity (YD) in the importing country (United States), the foreign currency price of imported goods (PF), the price of domestic goods that compete with imports (PD), and the exchange rate (ER) defined as pesos per dollar. Similarly, the export quantity demanded (QX) should be related to foreign income and/or economic activity (YF) in the foreign market (Mexico), the dollar price of exports (PD), the price of substitute goods in Mexico (PF), and the exchange rate (ER) defined as pesos per dollar.

A frequent practice in estimating the demand for imports and exports is to assume that the demand function is homogeneous of degree zero in price, in which case import and export prices are then defined jointly as a relative price. Under this approach, the relative price of imports is defined as RPM = ((PF/ER)/PD)*100. In an analogous manner, the relative price of exports is defined as RPX = (PD*ER/PF)*100.

In their simplest respective forms, United States imports from and exports to Mexico through the El Paso port-of-entry are stated in equations 1 and 2:

1. QM = f(+YD, -RPM)

2. QX = f(+YF, -RPX), where

QM = the volume of real imports by the U.S. from Mexico through the El Paso port-of-entry.

QX = the volume of real exports by the U.S. to Mexico through the El Paso port-of-entry.

YD = Industrial Production of the United States.
YF = Industrial Production of Mexico.
PD = the Wholesale Price Index of the U.S.
PF = the Wholesale Price Index of Mexico.
ER = the exchange rate defined as Mexican pesos per U.S. dollar.

The widespread adoption of floating exchange rates has led to an increased awareness that industrial market trade flows do not adjust instantaneously to changes in any of the variables that influence their behaviors over time (Deyak, Sawyer and Sprinkle, 1990; Demirden and Pastine, 1995). The J-curve phenomenon has also been confirmed for developing countries (Tegene, 1989). Given those observations, a common econometric practice to allow trade flows to adjust to their long-run equilibria following changes in any of their determinants is to specify the trade models with either geometric lags or a polynomial lag structure. Deployment of an ARIMA methodology to model the volume of imports and exports through the El Paso port-of entry allows the data to determine the lag structures and model forms without imposing any constraints prior to estimation.

In addition to the flexibility offered by ARIMA time series analysis, estimating the equations in this manner is useful because the individual sample series are autocorrelated. As Granger and Newbold (1974) point out, spurious regressions can frequently result when using ordinary least squares estimation techniques on serially correlated variables. Pierce and Haugh (1977) have shown that transfer functions estimated for such working series will preserve the causal relationships that exist between them. Accordingly, ARIMA models should offer an efficient method of testing the time series properties of regional customs district trade data.

United States imports and exports through the El Paso customs district to Mexico are reported on a monthly basis by the United States Department of Transportation Bureau of Transportation Statistics in a publication entitled ***Transborder Surface Freight Data***. The volumes of real imports and exports are computed by deflating the nominal values of the variables by the import unit value and export unit value measures, respectively, for the United States published by the International Monetary Fund in ***International Financial Statistics***. Monthly peso/dollar exchange rate, wholesale price index, and industrial production index data for the United States and Mexico are also published by the International Monetary Fund in ***International Financial Statistics***.

Empirical Results

For the data utilized in modeling trade flows through the El Paso port-of-entry, it is necessary to difference all of the series to obtain stationary working series. Stationary series have means (first moments) and variances (second moments) that do not change over time. Estimation results for imports by the United States from Mexico are presented in Equation 3. All of the regressor series are found to impact U.S. imports within a fairly short time frame. Regressor lag lengths appear in parentheses and none of the input variables have a lag length greater than ten months associated with them. While both the economic activity variable and relative price variable have coefficients with the expected algebraic sign associated with them, only the relative price variable satisfies the 5-percent significance criterion. Increases in economic activity in the United States lead to increased

imports from Mexico within ten months due to greater overall demand for Mexican produced goods. An increase in the relative price of imports from Mexico leads to a reduction of imports within 5 months. To handle serial correlation, a moving average term at lag 12 and autoregressive terms at lags 1 and 4 are included in Equation 3. Among the various diagnostic measures reported for equation 3, parameter t-statistics appear in the parentheses below their respective coefficient estimates.

3. United States Imports from Mexico through the El Paso Port-of-Entry

$$\Delta(QM) = \underset{(0.7429)}{13{,}091{,}536} + \underset{(0.2562)}{4{,}640{,}174} * \Delta(YD(-10)) - \underset{(3.4820)}{67{,}733{,}844} * \Delta(RPM(-5)) - \underset{(1.1463)}{0.1701} * AR(1) - \underset{(2.5101)}{0.2909} * AR(4) + \underset{(36.494)}{0.8768} * MA(12)$$

Adjusted R-squared	0.5768	Pseudo R-squared	0.8896
Log likelihood	-1638.35	Akaike	40.161
Schwarz	40.282	F-Statistic	23.086

Overall goodness-of-fit measures for Equation 3 are fairly strong. In particular, the F-statistic is significant at the 1-percent level. Also, the Pseudo R-squared of 0.8896 indicates that the estimated model explains nearly 89 percent of the monthly variation of imports through United States Customs District 24. Taken together, these measures imply that the model does a good job of explaining historical merchandise import flows through this regional trade corridor during the NAFTA era.

United States exports to Mexico estimation results are presented in Equation 4. Similar to the imports equation, all of the regressor series are found to impact United States exports through El Paso within a fairly short time frame. None of the input variables have a lag length greater than twelve months associated with them. The economic activity variable has a coefficient with the expected algebraic sign and is significant at the 5-percent level. Increases in economic activity in Mexico lead to increased merchandise exports from the United States within three months. Given the NAFTA-era sample period used herein, the rapid response to increases in industrial activity probably reflects greater overall demand for intermediate input goods used in Mexican in-bond assembly and other manufacturing plant activities. A very high percentage of merchandise trade between Mexico and the United States now occurs as intra-industry exchanges of goods subject to additional processing, a pattern that involves the extensive maquiladora districts of both Ciudad Juárez and Chihuahua (Ruffin, 1999; Clark, Fullerton, and Burdorf, 2001).

The relative price variable in Equation 4 has a lag of only two months and is also significant at the 5-percent level. Its negative sign implies that an increase in the relative price of exports from

the United States leads to a decline in merchandise export volumes through the El Paso customs district within 60 days. In addition to the economic activity and relative price variables, an autoregressive coefficient is included in the model at lag 12. Moving average terms are also included at lags 1 and 10. Among the various diagnostic measures reported for equation 4, computed t-statistics appear in the parentheses below their respective parameter estimates.

4. United States Exports to Mexico through the El Paso Port-of-Entry

$$\Delta(QX) = \underset{(0.6055)}{-1{,}701{,}770} + \underset{(2.5508)}{8{,}277{,}620 * \Delta(YF(-3))} - \underset{(2.2820)}{171{,}000{,}000 * \Delta(RPM(-2))} + \underset{(6.7445)}{0.6307 * AR(12)} - \underset{(8.1215)}{0.5973 * MA(1)} - \underset{(5.2133)}{0.3910 * MA(10)}$$

Adjusted R-squared	0.6012	Pseudo R-squared	0.8814
Log likelihood	-1606.83	Akaike	39.8230
Schwarz	40.0004	F-Statistic	22.6161

Overall goodness-of-fit measures for the exports equation are fairly strong. In particular, the F-statistic is significant at the 1-percent level. Also, the Pseudo R-squared of 0.8814 indicates that the estimated model explains a large percentage of the variation of United States merchandise exports to Mexico through the port of El Paso. Taken together, these measures imply that the model does a good job of explaining merchandise export movements through the El Paso customs district during the NAFTA-era.

Summary and Conclusions

Subsequent to the passage of the North American Free Trade Agreement, trade flows between Mexico and the United States have increased as a result of the reduction in trade barriers between the two countries. Much of this bilateral trade is processed through the El Paso – Ciudad Juárez regional ports-of-entry. This paper considers one aspect of this linkage between El Paso and Ciudad Juárez by analyzing monthly trade flows through United States Customs District 24.

Time series econometric techniques are employed as a means to quantify the empirical characteristics associated with these trade flows. The time frame under examination in this study is from January 1995 through December 2002. Results indicate that borderplex international trade responds fairly rapidly to changes in economic activity as well as changes in cross-border relative prices. Export and import flows do not, however, respond in identical time frames or in equal magnitudes to the market stimuli incorporated in the empirical analysis.

The results obtained imply that the geographic approach to bilateral trade flow analysis merits additional empirical testing at other ports-of-entry. Future research should take into account that these initial results encountered multicollinearity. Estimation of import and export equations with both longer and shorter time periods may uncover parameter instability due to structural breakpoints cause by large exchange rate changes, trade liberalization policies, or business cycle fluctuations within different trade partner pairs. Replication of these efforts for other border entry points such as Laredo – Nuevo Laredo and San Diego – Tijuana may help reveal additional information regarding merchandise trade between the United States and Mexico. Given the large volumes of trade between these two economies, additional empirical analysis will likely enhance current understanding of border trade and regional economic performance.

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