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Specification of a Borderplex Econometric Forecasting Model

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Abstract

Historically linked by geography, trade, and culture, border areas of the United States and Mexico are becoming even more closely integrated by the elimination of trade and investment barriers under the North American Free Trade Agreement. Greater economic integration raises the question of whether the traditional approach to regional econometric modeling is applicable to border metropolitan areas. This paper examines this issue with respect to the El Paso - Ciudad Juárez borderplex by specifying and estimating an econometric model and then simulating it under different currency conditions. Simulation output from the model is also compared and contrasted with extrapolations from a Bayesian vector autoregressive model. Results indicate that the traditional framework provides a viable means for analyzing international border region business trends.

Specification of a Borderplex Econometric Forecasting Model

Introduction

As trade and investment barriers are lowered between Canada, Mexico, and the United States, the international borderplex economy comprised by El Paso, Texas and Ciudad Juárez, Chihuahua is becoming increasingly intertwined. This trend raises a question with respect to the applicability of traditional regional econometric modeling analysis. Namely, can the traditional framework be modified in such a manner to maintain the overall accuracy and relevance with which these modeling efforts have been associated in recent years? To examine this issue, a border region econometric forecasting system is proposed and estimated. The goals of such a modeling effort still include business cycle forecasting, policy analysis, and applied economic research, but within the context of international border metropolitan areas.

As specified below, the initial model encompasses multiple sectors in the borderplex regional economy. A partial list includes demographics, personal income, employment, residential real estate, nonresidential construction, air transportation, international commerce, retail sales activity, water consumption, and "maquiladora" in-bond manufacturing activities. The borderplex model shares many of the standard satellite model characteristics of other metropolitan forecasting systems in that the WEFA Group national macroeconometric modeling system provides national historic and forecast data for most of the exogenous inputs to the local system. Regional historic data for the endogenous model components are obtained from a variety of sources. Increasing commercial and industrial ties to Mexico, however, suggests the incorporation of international endogenous and exogenous variables generally not utilized in other metropolitan models. Several different sources provide data for Mexico and Ciudad Juárez.

Subsequent sections of the paper are as follows. A short discussion of regional and international Latin American econometric modeling research is provided in the second section. A brief comparison of the classical regional modeling approach with the proposed border region framework follows. More detailed descriptions of the various sectors of the El Paso model are given in section four. The latter includes a comparison of simulation results between different versions the borderplex model and a Bayesian vector autoregression benchmark. Suggestions for future research are provided in the conclusion.

Regional and Latin American Modeling Research

The systems of equations approach to modeling, forecasting, and policy analysis for regional and national economies can be traced back to 1936 (Dhane and Barten, 1989). Its overall design flexibility has made it an invaluable tool corporate planning and public policy analysis. In the United States, these methods have been extensively applied to both regional and metropolitan economies during the past quarter century (Bolton, 1985). This is especially true in Texas where the Comptroller of Public Accounts maintains an extensive modeling system for the state, its 27 metropolitan areas, and its 254 individual counties (Plaut, Preuss, and Ferguson, 1996). Because the latter system is so large, most of the metropolitan models, including that for El Paso, are fairly small and not very detailed. The approach has also built an extensive track record with respect to the study of economies in Latin America (Fullerton and Araki, 1996). Sector specific models have also been developed for cross-border linkages between Mexico and the United States (Cobb, Molina, and Sokulsky, 1989; Sawyer and Sprinkle, 1986).

Modern times series analysis for regional modeling systems dates from 1969 (Pankratz, 1983). These models are especially useful in dynamic forecasting applications. They are also helpful in examining the quantitative impacts associated with new legislative and executive branch regulations and treaties such as the 1994 North American Free Trade Agreement (NAFTA) and the various peso devaluations that have been observed in Mexico from 1948 forward. Their flexibility has allowed them to be applied to a wide range of regional taxation issues in the United States (Fullerton, 1987) and international monetary topics in Latin America (Fullerton and Araki, 1996). Limited applications of these techniques to border region issues have also started to emerge in the academic literature (Fullerton, 1998).

Large scale regional modeling efforts for border regions have yet to be extensively developed. This is in part because the vast majority of all metropolitan and other sub-national economies are not located on international boundaries. For those located where two or more nations abut each other, institutional arrangements such as trade barriers have frequently reduced the degree to which the neighboring economies have become systematically linked. Finally, in most Latin American economies such as Mexico, the absence of economic decentralization away from national capitals further minimized the development of extensive cross-border business ties. Implementation of the North American Free Trade Agreement in 1994, plus other structural reforms such as Mexico's entry into the General Agreement on Tariffs and Trade, now under the umbrella of the World Trade Organization, have encouraged increased commercial relations between cities located along the United States - Mexico border. Consequently, extensive testing of the applicability of the traditional regional econometric modeling framework to cross-border business economies has not previously occurred.

Traditional and Border Region Econometric Model Constructs

A diagram of the traditional arrangement for regional and metropolitan econometric forecasting systems (Klein, 1969; West and Fullerton, 1996) is presented in Figure 1. Informally known as a top-down arrangement, it reflects that fact that regional business cycles are generally driven by their national counterparts. It also reflects the fact that greater detail is available for national economic data than for state data, and greater detail provided at the state level than at the county and metropolitan level (Bolton, 1985; Hunt and Snell, 1997). The classical satellite modeling arrangement expresses metropolitan variables as functions of both state and national exogenous variables, with state variables expressed as functions of national variables. Generally, there is very little feedback from the bottom up in the traditional approach to regional forecasting and policy analysis.

For borderplex economies such as El Paso - Ciudad Juárez, at least two sets of international business cycle considerations come into play that are not represented within the context of the original approach to regional econometric modeling (Klein, 1969). In addition to being affected by national economic trends in the United States, El Paso is also affected by national business cycle fluctuations in Mexico, as well as regional business patterns in Ciudad Juárez. Furthermore, in the specific case of the greater El Paso international metroplex, with five states and two nations affecting the local economy, the second set of equations represented in Figure 1 are more or less bypassed. This set of circumstances is depicted in Figure 2.

Recent economic history along the Mexican border in Texas succinctly reflects the differences between Figures 1 and 2. The "Tequila Effect" peso devaluation of December 1994 precipitated a severe recession in Mexico that lasted throughout 1995 and into the first quarter of 1996. During this period, the loss in Mexican consumer purchasing power coincided with the closure of approximately 60 retail outlets in El Paso and slower overall growth. Not to be overlooked, however, is that other segments of the El Paso economy benefited from the rapid expansion in "maquiladora" twin plant manufacturing activities. The latter expanded both output and employment in response to lower dollar equivalent wage costs subsequent to the devaluation (Vargas, 1995). Because of a strong maquiladora presence within its economic base, Ciudad Juárez was effectively shielded from much of the national downturn. In contrast, although some segments of the El Paso business sector were helped by expanding twin plant activity, the tequila effect, along with military downsizing at Ft. Bliss and energy sector corporate relocations, was sufficiently strong that this border economy lagged well behind the rest of the Texas state economy.

Readers should note that Figure 2 presents more than just an El Paso perspective on border region econometric modeling. From the perspective of Ciudad Juárez, the international business cycle impacts would emanate from both the El Paso metropolitan and the United States national economies. Of course, as the preceding discussion highlights, substantial feedback already exists between the El Paso and Ciudad Juárez metropolitan economies, a situation that will only intensify as NAFTA unfolds. A fully integrated econometric forecasting system must, therefore, take into account the endogeneity inherent in the cross-border economic relationships that are emerging between El Paso and Ciudad Juárez. Figure 2 also depicts the business cycle feedback that exists between the two national economies, as well as the direct linkages from industrial production in the United States to the "maquiladora" in-bond assembly plants on the south side of the international boundary.

Border Model Attributes

Even in the presence of the international business cycles discussed above, Figure 3 illustrates that the structure of the endogenous equation system comprising the border region metropolitan model is very similar to what would be associated with non-border metropolitan models (Bolton, 1985; Hunt and Snell, 1997). There are, however, two principal features that distinguish border and non-border models. As shown in the diagrams, a variety of international business cycle data are used as independent variables for many equation blocks. Also, border region models will generally contain completely separate blocks of equations designed to model the impacts and trends generated by international commerce. The relationship of such equation blocks to the El Paso model can be seen in Figure 3. Port city econometric models for areas such as Miami also contain vestiges of these elements (Fullerton, 1995; West and Fullerton, 1996), but to a lesser degree than that associated with the El Paso borderplex forecasting system.

The El Paso model is used for a variety of purposes. The most important is business trend monitoring and economic forecasting for the international borderplex region. While there are a small number of commercially available forecasts for El Paso County (Ellis, 1998; Prybolsky, 1998; Jordan, 1998), there are very few locally available sources of timely information regarding border business conditions that explicitly model international aspects of the economy. The El Paso border region model is also used in a variety of public policy analysis exercises such as the provision of simulation data utilized in testimony provided to the Texas State Senate regarding NAFTA adjustment efforts on the border.

To accomplish the aforementioned goals, sectoral coverage in the model is necessarily broad. Ten separate equation blocks are outlined in Figure 3. They include demographics, employment, income, labor earnings by industrial activity, retail sales, residential real estate, nonresidential construction, maquiladora activity, northbound international border crossings, and transportation and public utilities. As shown in the diagram, the structure of the model is highly simultaneous with numerous direct and indirect feedback loops connecting the various sectors of the model.

Readers may be surprised to observe that only recursive linkages exist between the central core of the model and the nonresidential construction, international bridge crossing, and transportation equation blocks. The latter is partially due to data constraints in the form of statistical degrees of freedom limitations. It should not, therefore, be interpreted as reflecting non-central roles of any of those sectors in the metropolitan economy. As more econometric information becomes available, it is likely that statistically significant endogeneity will become apparent between these equation blocks and the other segments of the border region model.

The current version of the border forecasting system contains 129 equations offering at least partial detail for each of the different blocks of endogenous equations shown in Figure 3. Statistical output for the econometric equations currently comprising the borderplex model are available from the author. Included in the 129 equations are 28 identities and 101 stochastic equations. Multiple specifications were tested for many of regression equations. Of the 101 fitted results ultimately selected, most exhibit good statistical traits, but nearly all contain at least partial design and/or empirical flaws.

Serial correlation correction techniques are required in 33 of the 101 regression equations. Thirteen cases of autoregressive, fifteen moving average, and five mixed data generating processes are observed in the affected residual series. Nine of the corrected equations involved second order autocorrelation dynamics. Because annual frequency data are used, it is not surprising that higher order serial correlation is not encountered. That nearly one-third of all the border model stochastic specifications require autocorrelation correction in part reflects widespread data constraints that also affect traditional regional econometric modeling efforts (Fullerton and West, 1999) as well as standard Latin American forecasting models (Fullerton and Araki, 1996).

The population and demography segment of the model covers resident births and deaths, immigration, and household formation trends. Unlike other fast-growing regions of the United States (West and Lenze, 1999), natural increase typically accounts for greater than 75 percent of all population growth in El Paso (Fullerton, 1999). The remainder is provided by net migration, a composite variable that frequently turns negative when border economic conditions falter relative to the rest of the United States. Modeled stochastically, net migration is a function of national, international, and regional income and employment variables. Other specifications utilized in this block are similar in structure to those used in other regional models in prediction of population aggregates with limited time series parameter augmentation (Pflaumer, 1992).

Eight equations comprise the personal income block of the border model. Wage and salary disbursements, other labor income, proprietor earnings, personal contributions to social insurance, residence adjustments, dividend, interest, and rental incomes, and transfer payments comprise the individual stochastic equations in a framework analogous to that of national income modeling efforts (Staranczak and Karl, 1998). Each of the specifications is built around a combination of local performance variables and national ratio measures. Transfer payments, primarily income maintenance and retirement pensions, account for approximately 23 percent of total personal income in El Paso. Despite a younger population profile in the borderplex, the former represents a substantially higher percentage than in other parts of the United States where transfers total less than 17 percent of personal income

A fourteen equation block is utilized to model labor and proprietor earnings by industrial classification. All of the private sector earnings categories are modeled as functions of overall sectoral employment and the corresponding national wage rate adjusted for inflation by an appropriate price index. Although border localization factors (Hanson, 1996) cause El Paso wages to generally lag the rest of the nation, this is a level effect and earnings by industrial segment are still highly correlated with the United States labor market as a whole. A variety of revenue and expenditure series are used to proxy public sector wage trends in the four government labor earnings categories.

Employment by industrial classification and the civilian labor force are modeled by a block containing fifteen equations, twelve of which are behavioral. The unemployment rate is calculated by means of an identity. The civilian labor force is functionally dependent on total demand for labor and population scaled by a one period lag of the county labor force participation rate. Private sector job specifications rely upon a combination of autoregressive lags, national real wage rate movements, and various local and national industrial activity and technical change measures. Federal civilian and federal military employment are functions of constant dollar national nondefense and defense expenditures, respectively. Given the reliance of El Paso on natural increase as its principal source for population growth, it is not surprising that local government payrolls continue to expand due to the serious enrollment pressures confronting public school districts. A two-year moving average of the county population is used as a proxy for increases in the numbers of school-aged children on the El Paso side of the border.

Retail sales activities, both gross and taxable, are forecast by means of an eighteen equation sub-system that includes two identities. Coverage of real sales volumes is at the two-digit standard industrial classification (SIC) level of disaggregation. All eight taxable sales equations are specified as functions of their corresponding gross retail sales categories. This approach is useful since the latter encompass all sales, irrespective of whether they have been exempt from sales tax assessment by the state legislature. Gross retail sales equations in the model generally include a combination of right-hand side variables such as metropolitan real personal income, the inflation adjusted value of the Mexican peso, and national consumer confidence in the United States (Carroll, Fuhrer, and Wilcox, 1994; Sawyer and Sprinkle, 1986). Retail activity in El Paso typically suffers whenever Mexican consumer purchasing power is reduced by large-scale devaluations such as those observed in 1949, 1976, 1982, 1986, and 1994. Not surprisingly, Mexican customer traffic across the border is directly impacted by changes in the value of the peso (Anonymous, 1998; Totty and Barta, 1997).

An eleven equation sub-system is used to characterize residential construction and real estate in El Paso, reflective of the overall importance of this segment of any regional economy (Zandi, 1999). Given the typical difficulties associated with housing start forecasts (Fullerton and West, 1998), broader coverage has been included to augment the overall usefulness of this portion of the model. Variables modeled in this block include local housing affordability, average monthly housing payments, median prices for existing and new homes, single-unit and multi-unit starts, single-family and multi-family home sales, and single- and multi-unit stock levels. For nonresidential construction, a set of five equations is utilized to analyze trends in industrial, office, retail, and miscellaneous space throughout the metropolitan area on the north side of the border.

Transportation and public utilities are usually omitted from multi-equation regional econometric forecasting systems. The model at hand partially overcomes this customary gap with a ten-equation sub-system encompassing air passenger, freight, and mail flows through the El Paso International Airport. Domestic passenger traffic is forecast as a function based upon metropolitan real wage and salary disbursements and a real price variable for air travel (see Howry, 1969). International passenger flows are dependent upon the inflation adjusted value of the peso and the relative price index for air transportation (González and Moral, 1995). A combination of national and border region variables are used to model freight and air mail shipments and deliveries.

Northbound bridge traffic from Mexico is modeled with a block of fifteen equations, eleven of which are stochastic. Coverage in this portion of the model is confined to northbound border commuting across the three bridges that are within the El Paso city limits and excludes other commercial data as a consequence of time series information constraints. Merchandise trade statistics for El Paso extend back only to 1993, precluding the estimation of trade flow equations that might otherwise be of interest to policy analysts and corporate planners. Four categories of traffic flows are included in the current version of the border model: personal automobiles, cargo vehicles, pedestrians, and total persons. More than 50 million passengers are estimated to have crossed the border using these arteries in 1998. Not surprisingly, a complicated mix of national and international exogenous variables plus border region endogenous data are used in the specifications for this sub-system.

At present, consistent time series data for the Ciudad Juárez metropolitan economy are available only for the maquiladora in-bond assembly industry. The model incorporates this important, and relatively unique, segment of the borderplex economy in an endogenous fashion. As illustrated in Figure 3, linkages from this block of equations directly affect both the bridge crossings and retail sales sub-systems for the El Paso portion of the framework. Series modeled include maquiladora employment, total plants in operation, average dollar wage rates, and output. Regressors include a variety of macroeconomic and regional variables from both sides of the river.

Simulation Results

The preceding section provides descriptive insights with respect to the overall structure of the borderplex model. It does not shed any light with respect to its general forecast reliability. To examine this question, a straightforward simulation exercise is devised in at least partial accordance with the guidelines proposed by West (1995). Typically, extrapolations from univariate ARIMA equations are regarded as the most reliable benchmarks against which structural model performance should be measured (Granger, 1996). Because annual data are incorporated into the border model, small sample sizes preclude following this common practice.

To circumvent this obstacle, a Bayesian vector autoregression (BVAR) model is used to provide the out-of-sample simulations that provide the backdrop against which the structural model results are compared. The BVAR framework is selected for two reasons. One is that while El Paso and Ciudad Juárez are noticeably impacted by national business cycle fluctuations in their respective countries, neither side of the borderplex is large enough to generate statistically noticeable impacts on national income data assembled for the United States or Mexico. Consequently, national data are included in the specifications of the regional equations, but not the reverse. Second, a BVAR system is less profligate with respect to degrees of freedom loss than is a full-fledged vector autoregressive model (Runkle, 1987). The latter consideration is important when dealing with regional data sets where sample observations are in limited supply.

To further examine whether the partial extension of the traditional metropolitan modeling framework has been carried out successfully, a second version of the borderplex model is estimated that omits all cross-border national and metropolitan data series from the individual equation specifications. If these variables play important roles in correctly specifying the model, their omission should cause estimation and simulation properties of the resulting model to differ from the fully specified structural model. If, however, the modified approach to border region modeling discussed above is unnecessary, the simulation results of the "stripped-down" version of the model should be very similar to those of the cross-border specification presented above. One noticeable change in the estimation results indicates that inclusion of the international variables is helpful. Exclusion of these data causes the number of equations requiring serial correlation correction to rise from 33 to 41 out of the 101 total stochastic specifications.

Tables 1A, 1B, and 1C summarize the comparative performance of the three models utilizing a three-year baseline simulation exercise. The three-year out-of-sample period length is selected to reflect the typical forecast period for which the border model is currently utilized (Fullerton, 1999). Variables reported for El Paso in the simulation test include population, total employment, real personal income, and retail sales activity, also adjusted for inflation. For Ciudad Juárez, maquiladora employment is the only series reviewed in the tabular output.

As shown in Tables 1A through 1C, the baseline trend simulations of the three models exhibit interesting differences. El Paso population is projected to grow at 1.9 percent per year for the fully specified structural simulation, while the domestic version of the structural model projects a 1.7 percent rate of change or all three years, and the BVAR forecast calls for steady declines in the rate of change. The lower demographic growth rates that result for the domestic version of the border model and the BVAR model are potentially important. That is because the generally large international component associated with local population variation is apparently not completely accounted for by including autoregressive lags in the reduced scope models.

It is not surprising that the fully specified border model also predicts a higher rate of jobs growth than do the domestic and BVAR models. The latter contention is based upon the higher demographic projections generated by the fully specified system of structural equations. Slow deceleration in real income growth is projected by the border model, but at rates that consistently remain above the domestic and BVAR trend scenarios. The latter results hinge at least partially on the respective employment forecasts of each model. In the case of the domestic structural model, however, omission of the cross-border variables from segments such as retail sales activity also represents a contributing factor.

For retail sales, the average growth rate for the border model exceeds those generated by the alternative models. A greater level of variability is observed with respect to the direction and rates of change for the three series. The latter is probably reflective of higher standard deviations and wider prediction intervals for retail sales volumes in El Paso and other regional economies in general. All three sets of trend extrapolations point to declining employment growth rates in the maquiladora segment of the Ciudad Juárez metropolitan economy, but the structural model forecasts exceed those associated with the BVAR counterpart for the complete out-of-sample simulation period.

Impacts from a 50 percent real devaluation similar to that observed in December 1994 are examined in Tables 2A, 2B, and 2C. The inflation adjusted peso index falls 50 percent relative to the dollar in the first year. It then strengthens back to its original base year value in a linear fashion over the next two years in the simulation period. Effects on population growth are substantial for the border and BVAR model projections, but not for the domestic structural forecast. An immediate sharp decline in employment growth is observed for the border model in Table 2A. Due to its lag structure, job market deceleration does not occur until the second period in the BVAR simulation. The downward employment effect is more protracted in the structural model scenario than in the BVAR simulation. Not surprisingly, the domestic model employment forecast does not react to the large scale devaluation of the peso (Table 2B).

Similar impacts are observed with respect to real income performance. For the fully specified structural model, income growth drops below the baseline in the first period and remains sluggish in a manner to overall employment. In the case of the domestic specification (Table 2B), the growth path for real income tracks employment fairly closely. For the BVAR model, the metropolitan income reaction to the devaluation is not observed until the second period but is noticeably downward.

Retail sales, in constant 1992 dollars, follow erratic paths subsequent to the peso devaluation. For the border model, total sales fall in real terms in the first year, but recover in the next two periods (Table 2A). For the domestic model, Table 2B, retail sales grow steadily in all three periods in a pattern that is clearly out of line with the previous loss of value in the peso (Fullerton, 1999). The BVAR simulation also fails to match the previous retail response to large scale depreciation. Shrinkage in gross retail activity is observed for all three forecast periods in Table 2C.

Substantially higher maquiladora job growth occurs in all three model simulations following the devaluation. The resulting forecast paths, however, differ noticeably from model to model. Double digit rates of payroll expansion occur in the first two years of the border model forecast, with rapid growth also observed in the final period shown in Table 2A. Much lower, but still positive rates of increase occur in the domestic model simulation. Because of the lag structure imposed on the BVAR model, accelerated maquiladora jobs growth does not occur until the second period (Table 2C).

As shown in Tables 1 and 2, different patterns emerge from simulating each model beyond the end of the sample estimation point. There is enough overlap of the test results to indicate that the model forecasts will frequently concur and potentially even err in the same direction as is the case with their macroeconometric predecessors (Zarnowitz and Lambros, 1987; Granger, 1996). Given the degree of freedom constraints imposed on regional estimation efforts for *both* sides of the border, it probably makes sense to employ the structural approach discussed above for large-scale forecasting efforts. Extrapolation "sanity checks" could be fairly easily and reliably conducted via the time honored random walk comparisons long-employed by practitioners (Fullerton and West, 1998). The slightly modified structural framework does prove attractive from the vantage point of offering a comprehensive mechanism for simultaneously examining multiple segments of border region economies and at least partially accounting for international business cycle developments.

Conclusion

The design and specification of a forecast model system for any regional economy is a difficult endeavor. For border metropolitan regions, that task is even more complicated than usual due to important demographic, commercial, and industrial linkages with contiguous international economies. In the case of El Paso, the local economy is impacted by national business cycles in the United States and Mexico, as well as the regional business cycle associated with Ciudad Juárez. Similar to El Paso, economic conditions in Ciudad Juárez frequently diverge from those observed for the rest of the Mexican macroeconomy. This study discusses one approach to accounting for these considerations by partially modifying the traditional regional econometric modeling framework.

A 129 equation model of the El Paso borderplex has been developed and utilized to examine local economic conditions. Coverage goes beyond what is typically encountered in most regional models to include telephone connections and water consumption by user-class, as well as detailed housing affordability and price trends. Also incorporated into the system are international ground and air transportation flows from Mexico, plus maquiladora activities in Ciudad Juárez. With only two published forecasts comprising its record to date, it is not feasible to formally assess its *ex ante* simulation performance along the lines suggested by West (1995). It is, however, possible to monitor forecast performance over time and avoid committing systematic errors of over-prediction or under-prediction for individual variable categories (Granger, 1996). Comparative simulation performance of this model relative to two other constructs uncovered interesting results along these lines.

Data constraints preclude replicating the El Paso level of detail for metropolitan economic activity on the south side of the Rio Grande. Collaborative efforts are underway with a variety of research units in Mexico to assemble a data bank that will support the creation of model similar in scope to some of the regional econometric forecasting systems utilized in other developing countries facing provincial information limits (Kim, 1995). The latter effort includes water consumption in Ciudad Juárez. Completion of that effort will permit implementing the fully integrated cross-border simultaneous system of equations illustrated in Figure 2.

One step that has proven successful with respect to model enhancement is maquiladora sector modeling for Ciudad Juárez. Existing models for in-bond assembly activity in Mexico are constructed at the state and national levels of aggregation (Christman, 1998). Sufficient data are now available to model employment, plant-site development, wages, industrial component imports, and value-added at the metropolitan level. Given its long history and enormous scale, maquiladora activity in Ciudad Juárez differs substantially from fast-growing smaller areas in the interior of Mexico. Metropolitan level econometric modeling represents a potentially useful strategy in the analysis of the regional impacts associated with direct foreign investment.

Border region econometric forecasting analysis is in its infancy. Rapidly expanding economic linkages between borderplex metropolitan areas will undoubtedly serve to spur these efforts as trade and investment continue to be deregulated. This initial research for El Paso offers a potential blueprint for other border areas and suggests additional venues for improvement. As apparent from previous regional modeling research (Rey, 1998; Shoesmith, 1992; West, 1995), there is no compelling reason to believe that any single methodology will ever prove universally superior to all others. Data constraints as well as modeling goals and pitfalls will probably drive subsequent efforts along these lines. Numerous analytical strategies exist that will likely yield beneficial insights to better understanding of border region economic performance.

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Table 1A
Border Model Trend Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.9%	1.9%	1.9%
ELEMP	2.0%	1.8%	1.6%
ELINC	3.5%	3.2%	2.8%
ELRET	4.3%	2.2%	3.4%
CJMQM	8.8%	7.6%	4.5%

Table 1B
Domestic Model Trend Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.7%	1.7%	1.7%
ELEMP	1.7%	1.3%	1.0%
ELINC	2.8%	1.9%	2.5%
ELRET	1.6%	2.1%	1.5%
CJMQM	6.4%	5.9%	5.0%

Table 1C
BVAR Model Trend Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.6%	1.2%	0.9%
ELEMP	1.2%	1.5%	1.4%
ELINC	2.6%	2.2%	2.4%
ELRET	6.6%	-2.5%	1.8%
CJMQM	5.9%	3.7%	3.0%

Table Acronyms:	ELPOP	El Paso Population
	ELEMP	El Paso Total Employment
	ELINC	El Paso Real Personal Income
	ELRET	El Paso Inflation Adjusted Retail Sales Activity
	CJMQM	Ciudad Juárez Maquiladora Employment

Table 2A
Border Model Peso Devaluation Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.2%	1.7%	1.9%
ELEMP	0.9%	0.8%	1.1%
ELINC	2.2%	2.3%	2.2%
ELRET	- 2.1%	4.9%	3.4%
CJMQM	13.8%	10.6%	9.5%

Table 2B
Domestic Model Peso Devaluation Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.7%	1.7%	1.7%
ELEMP	1.3%	1.2%	1.2%
ELINC	2.6%	2.5%	2.4%
ELRET	4.5%	3.2%	4.0%
CJMQM	7.8%	6.9%	3.3%

Table 2C
BVAR Model Peso Devaluation Simulation

Series	Year 1	Year 2	Year 3
ELPOP	1.5%	0.4%	0.2%
ELEMP	1.8%	0.1%	2.1%
ELINC	2.4%	0.3%	3.6%
ELRET	- 4.3%	- 3.7%	- 2.1%
CJMQM	5.5%	11.6%	8.7%

Table Acronyms:		
	ELPOP	El Paso Population
	ELEMP	El Paso Total Employment
	ELINC	El Paso Real Personal Income
	ELRET	El Paso Inflation Adjusted Retail Sales Activity
	CJMQM	Ciudad Juárez Maquiladora Employment

FIGURE 2 Borderplex Model Design