The U.S.-Mexican borderlands region: a binational spatial analysis

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Abstract

The study addresses research questions about demographic, social, and economic characteristics of the joint U.S.-Mexico border region. The study sample consists of all of the counties and municipios in the U.S.-Mexico border region i.e. all those in the U.S. four border states (California, Arizona, New Mexico, and Texas), as well as those in the six Mexican border states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas). There are 246 counties and 273 municipios in this region. The goal of this research is to understand the broader context of the border region and to compare the results to prior studies of the border region and its cities. It examines the levels of the 16 matched characteristics at the county and municipio level in the territory of the ten border states. The methods consist of definitional matching and descriptive spatial analysis and comparisons. The findings are summarized to answer the research questions. Do socioeconomic characteristics in the border region differ between the U.S. and Mexico? Do they differ between the eastern versus western borderlands? Do characteristics differ for the major metropolitan versus non-metropolitan areas of the borderlands? Are city to city differences (north to south) similar or different to region to region differences (north to south)? This paper seeks to answer these questions, discuss the findings, compare the results to prior work, and analyze the policy and planning implications. © 2001 Elsevier Science Inc. All rights reserved.

1. Introduction: population growth in the U.S.-Mexico border-adjacent municipios

The U.S.-Mexico borderlands region has grown in importance over time. This is the consequence of its improved economy, greater trans-border linkages, and growing population. One important aspect of border development has been its rapid population growth. This

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aspect influences the discussions in this paper on the spatial distribution of socioeconomic characteristics in the borderlands. It will serve as an introduction to the theme of the paper.

The respective border regions have grown in the past half century as a proportion of the two nations (see Fig. 1). While Texas, New Mexico, Arizona, and California constituted 13.0 percent of the U.S. population in 1950, they increased to 21.6 percent in 2000 (see Table 1). The U.S. border region grew over the 50 years about 115 percent faster annually than the rest of the nation, which reflects a long-term trend of migration to the “Sunbelt.” The four U.S. border states continued to grow in the 1990s faster than the nation (Long, 2000). From 1990 to 2000, the U.S. population grew by 14.7 percent, while the four U.S. border states increased by 18.8 percent (U.S. Census, 2001). In 2000, there was a population of 61.7 million in the U.S. border states.

Likewise the proportion of Mexican national population in the six border states grew during the entire twentieth century. In 1950, the six Mexican border states of Tamaulipas, Nuevo Leon, Chihuahua, Coahuila, Sonora, and Baja California constituted 14.8 of the national population, rising to 17.1 percent in 2000 (Pick and Butler, 1994; INEGI, 2001). The border region’s annual growth rate over the half century from 1950 to 2000 was 12 percent higher than the remainder of Mexico. Although in Mexico the border’s growth approximated that of the nation, both grew faster than for the U.S., for instance the Mexican border grew annually 30 percent faster than the U.S. border over the fifty years.
A rapidly increasing part of the border population on both sides has been the U.S.-Mexico border twin cities, i.e. binational cities immediately adjacent to the border. Table 2 gives the populations of counties and municipios containing border twin cities for 1930 through 1990, and also includes year 2020 projections from Peach and Williams (2000).

The aggregated total population of the counties and municipios containing the border twin cities grew rapidly in the 20th century and is projected to continue to expand. In 1930 the aggregated population of the counties and municipios containing twin cities was three quarter million. It rose to 3.1 million in 1970 and 7.2 million in 2000 (see Table 2). Peach and Williams (2000) project as a medium estimate that the counties and municipios containing border twin cities will reach 15.8 million in population by year 2020. The 90 year estimated yearly growth of 3.4 percent is very fast, resembling rapidly growing third world nations. Also as seen in Table 2, the growth rate was two percent greater for Mexico than for the U.S.

In sum, the rapid and continuing demographic growth of the border and especially its border cities has been a key factor underlying the region’s enhanced importance to Mexico, the U.S., and to all of North America.

2. Background—prior research

The U.S.-Mexico border region has been of interest to scholars over the past three decades. Studies have been conducted from a variety of disciplinary perspectives, including
Table 2
Populations of U.S.-Mexico border twin-city counties and municipios, 1930-2020 (projected)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Matamoros, Tamaulipas</td>
<td>9,733</td>
<td>45,846</td>
<td>140,660</td>
<td>303,295</td>
<td>736,891</td>
<td>4.8</td>
</tr>
<tr>
<td>Cameron (incl. Brownsville, Texas)</td>
<td>77,540</td>
<td>125,170</td>
<td>140,368</td>
<td>260,120</td>
<td>554,307</td>
<td>2.2</td>
</tr>
<tr>
<td>Cameron-Matamoros</td>
<td>87,273</td>
<td>171,016</td>
<td>281,028</td>
<td>563,415</td>
<td>1,291,198</td>
<td>3.0</td>
</tr>
<tr>
<td>Reynosa, Tamaulipas</td>
<td>4,840</td>
<td>34,087</td>
<td>140,480</td>
<td>282,666</td>
<td>658,403</td>
<td>5.5</td>
</tr>
<tr>
<td>Hidalgo (incl. McAllen, Texas)</td>
<td>77,004</td>
<td>106,446</td>
<td>181,535</td>
<td>383,545</td>
<td>1,050,166</td>
<td>2.9</td>
</tr>
<tr>
<td>Hidalgo-Reynosa</td>
<td>81,844</td>
<td>140,533</td>
<td>322,015</td>
<td>666,211</td>
<td>1,708,569</td>
<td>3.4</td>
</tr>
<tr>
<td>Nuevo Laredo, Tamaulipas</td>
<td>21,636</td>
<td>57,668</td>
<td>152,325</td>
<td>219,465</td>
<td>633,770</td>
<td>3.8</td>
</tr>
<tr>
<td>Webb (incl. Laredo), Texas</td>
<td>42,128</td>
<td>56,141</td>
<td>72,859</td>
<td>133,239</td>
<td>407,110</td>
<td>2.5</td>
</tr>
<tr>
<td>Webb-Nuevo Laredo</td>
<td>63,764</td>
<td>113,809</td>
<td>225,184</td>
<td>352,704</td>
<td>1,040,880</td>
<td>3.1</td>
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<tr>
<td>Piedras Negras, Coahuila</td>
<td>15,878</td>
<td>27,581</td>
<td>40,885</td>
<td>98,184</td>
<td>231,580</td>
<td>3.0</td>
</tr>
<tr>
<td>Maverick (Eagle Pass), Texas</td>
<td>6,120</td>
<td>12,292</td>
<td>18,093</td>
<td>36,378</td>
<td>94,495</td>
<td>3.0</td>
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<td>Maverick-Piedras Negras</td>
<td>21,998</td>
<td>39,873</td>
<td>58,978</td>
<td>134,562</td>
<td>326,075</td>
<td>3.0</td>
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<tr>
<td>Ciudad Juarez, Chihuahua</td>
<td>39,669</td>
<td>122,566</td>
<td>414,908</td>
<td>798,500</td>
<td>2,395,024</td>
<td>4.6</td>
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<tr>
<td>El Paso, Texas</td>
<td>131,597</td>
<td>194,968</td>
<td>359,291</td>
<td>591,610</td>
<td>1,103,065</td>
<td>2.4</td>
</tr>
<tr>
<td>El Paso-Ciudad Juarez</td>
<td>177,266</td>
<td>317,534</td>
<td>774,199</td>
<td>1,960,110</td>
<td>3,498,089</td>
<td>3.4</td>
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<tr>
<td>Nogales, Sonora</td>
<td>14,061</td>
<td>24,478</td>
<td>53,119</td>
<td>107,937</td>
<td>299,598</td>
<td>3.4</td>
</tr>
<tr>
<td>Santa Cruz (Nogales), Ariz.</td>
<td>14,061</td>
<td>30,631</td>
<td>62,056</td>
<td>137,613</td>
<td>371,394</td>
<td>3.6</td>
</tr>
<tr>
<td>Mexican, Baja California</td>
<td>14,842</td>
<td>65,749</td>
<td>276,167</td>
<td>601,938</td>
<td>1,232,953</td>
<td>4.9</td>
</tr>
<tr>
<td>Imperial County, California</td>
<td>60,903</td>
<td>62,975</td>
<td>74,492</td>
<td>109,303</td>
<td>327,790</td>
<td>1.9</td>
</tr>
<tr>
<td>Imperial-Mexicali</td>
<td>75,745</td>
<td>128,724</td>
<td>350,659</td>
<td>711,241</td>
<td>1,560,743</td>
<td>3.4</td>
</tr>
<tr>
<td>Tijuana, Baja Calif.</td>
<td>8,384</td>
<td>59,952</td>
<td>341,067</td>
<td>747,379</td>
<td>2,676,672</td>
<td>6.4</td>
</tr>
<tr>
<td>San Diego, California</td>
<td>209,659</td>
<td>334,387</td>
<td>696,769</td>
<td>2,498,106</td>
<td>3,294,769</td>
<td>3.1</td>
</tr>
<tr>
<td>San Diego-Tijuana</td>
<td>218,043</td>
<td>394,339</td>
<td>1,037,836</td>
<td>3,245,485</td>
<td>5,971,441</td>
<td>3.7</td>
</tr>
<tr>
<td>Mexican twin city municipios</td>
<td>129,043</td>
<td>437,927</td>
<td>1,559,611</td>
<td>3,159,364</td>
<td>8,864,891</td>
<td>4.7</td>
</tr>
<tr>
<td>U.S. twin city counties</td>
<td>604,951</td>
<td>898,532</td>
<td>1,552,353</td>
<td>4,041,977</td>
<td>6,903,498</td>
<td>2.7</td>
</tr>
<tr>
<td>Twin city totals</td>
<td>733,994</td>
<td>1,336,459</td>
<td>3,111,964</td>
<td>7,201,341</td>
<td>15,768,389</td>
<td>3.4</td>
</tr>
</tbody>
</table>

* Averaged over seventy year period 1950-2020.


Economic, geographic, demographic, urban-rural, sociological, and cultural (see for example, Stoddard et al., 1983; Dillman, 1983; Fernandez, 1989; Martinez, 1993; Herzog, 1990; Arreola, 1993; and Schafer and Pick, 2000). This section provides a brief summary of several studies relevant to the present paper because they help elucidate the causes and impacts of the region’s economic and demographic growth.

Dillman in 1983 explained demographic trends in the border region, including its high fertility and natural increase, elevated domestic in-migration especially on the Mexican side, high rural-to-urban migration leading to urbanization, movement of illegal contraband, movement from Mexico to the U.S. of migrants and illegal drugs, and expansion in the maquiladora industry in Mexico. These trends are still present today. Dillman also observed that, while the U.S. border region has experienced more economic hardship and poverty than the U.S. as a whole, the Mexican border has been better off than Mexico as a whole. Dillman
referred to this as "convergence," i.e. that the border region forms an intermediate entity between the two nations. Based on 1980 census data, Pick and Butler (1990) confirmed that this "convergence" exists for key marginality variables, such as low income and low education. This may help to explain the melding of social and behavioral characteristics in the border region, which Martinez (1993) termed "border people," and today sometimes is referred to in the media as "Amexica" (Time, 2001).

Dillman also pointed to the rapid population growth of the border, which was due mostly to domestic in-migration. Mexicans migrated to the border because of the perceived prosperity of some destinations. Further, some migrants moved to the border as a holding zone for migration into the U.S. Dillman identified the maquiladora as a key economic driver and attractor of workforce. Further, the maquiladora industry on the Mexican side contributed to an enhanced proportion of service workers and reduced agricultural workers than for the rest of the nation. He pointed out that the lack of governmental response to the border problems on the Mexican side may have stemmed both from the traditional weakness of the municipio and state governments and from the distant federal government's lack of interest and support for solving border problems.

Dillman identified poverty as lower in the Mexican border region, compared to the rest of Mexico, but much higher in the U.S. border, relative to the rest of the U.S. In particular, poverty was at record U.S. levels in the lower Rio Grande Valley. He went further and ascribed the high poverty to pre-existing educational and job skills deficits of border Latinos, coupled with the increased job competition from even less skilled Mexican migrants or temporary workers. The job pressures led to high unemployment, or to outmigration. The outmigrant response is exemplified by Imperial County, which from 1940 to 1990 had substantial outmigration (Butler and Pick, 1982; Pick et al., 2000a).

Another pertinent study of the U.S.-Mexico border region (Fernandez, 1989) focused on industrial development, maquiladoras, border cities, planning challenges, and negative development externalities. Broadly speaking, Fernandez underscores that the binational region experienced industrial, particularly maquiladora, expansion and concomitant rapid population growth, yet was constrained by scarcity of water, and limited agricultural potential. At the same time, it is advantaged by certain potential energy resources, including gas and petroleum in Texas, gas deposits in Mexico, and geothermal energy in Mexicali. However, the region needs to develop these energy resources. In sum, he portrays a region with population growth that is constrained by natural resource constraints which limit the border industrialization and by lack of planning on the Mexican side and to a lesser extent on the U.S. side.

"Dichotomies" exist on both sides in manufacturing and agriculture (Fernandez, 1989). By this, he refers to the presence of large efficient businesses alongside small, family-owned enterprises. On the Mexican side, the maquiladora is juxtaposed with small informal manufacturing and supply enterprises; agribusiness exists alongside small peasant farms.

Fernandez points out that the maquiladora industry has several inherent problems that lead to negative externalities. A fundamental flaw from the beginning in the maquiladora concept is that it did not provide Mexico with capital goods for its domestic market, which Mexico badly needed in the second half of the twentieth century, but instead sold goods almost exclusively into the U.S. market. Further, the maquiladora industrialization and rapid pop-
ulation growth led to adversities including environmental impacts on native vegetation, air pollution, water pollution, and changes to natural river flows and lakes.

Both these studies underscore the transformation of the border region based on diversion of scarce water supply, shift to agri-business, maquiladora growth, expanded urbanization, and domestic in-migration. In the border cities, the transformation altered the urban order, although the details are left out. Both studies regard the border in many respects as a different “country,” an idea that has recently been referred to as “Amexica” (Time, 2001). On the Mexican side, Fernandez sees the border region being transformed from a laggard to a leader, rising steadily in economic and demographic importance to the nation.

Another backdrop to the present research are studies of the U.S.-Mexican border cities (Herzog, 1990; Arreola and Curtis, 1993; Pick et al., 2000a,b, 2001). These studies examine the urban dynamics, growth, and characteristics of the border cities, where three quarters of the borderlands population lives. Herzog (1990) studied the San Diego-Tijuana urban system from the standpoints of historical growth, spatial structure, environment, culture, and politics. He explains how this twin city grew and developed and why cross-border interactions did or did not occur. Arreola and Curtis (1993) studied the Mexican border cities, emphasizing urban structure, morphology, city planning, and human landscapes. They present a conceptual model of the urban structure of a typical Mexican border city, and they also discuss the cities’ housing, settlement patterns, transportation, and industrial parks. They describe unique city designs and arrangements that differ from U.S. cities or other cities in Mexico.

Pick et al., (2000a,b, 2001) analyzed the urban structure of border cities based on 1990 U.S. and Mexican census data. They utilize matched variable definitions between the nations’ 1990 censuses i.e. to allow combined binational data sets. The unit of analysis is the block group on the U.S. side and the AGEB (area geografica estadistica basica) in Mexico, i.e. units of 1,500–2,500 population. Binational spatial patterns are analyzed for groups of population, economic, social, and housing variables. A similar set of matched variables is applied in the present research, but at the county and municipio level. They test the geographical patterns against urban structural models, in particular those of concentric rings (Burgess), sectors (Hoyt) and Hoffman’s border city model. They found that the urban structure of the two sides of the border differs, with more adherence to ring and border city models in Mexico, and more correspondence to the sector model on the U.S. side. Cluster analyses reveal the extent of commonalities or differences between the two sides. In general, the two sides of the cities are very different socioeconomically, with population attributes having the most commonality and housing ones the least, although results vary by city.

3. The research questions

The present research builds on this prior work by applying spatial analysis techniques to examine socioeconomic patterns and changes for the border in 1990. In particular, the investigation seeks to answer the following research questions:

Research question 1. Are there substantial differences between the U.S. and Mexican border regions for the geographic patterns of 16 socioeconomic and demographic variables?
Research question 2. Are there substantial differences between the eastern and western border strips of the U.S. and Mexico for the geographic patterns of 16 socioeconomic and demographic variables?

Research question 3. Are there significant differences on 16 socioeconomic and demographic characteristics between the major metropolitan areas and other, non-major metropolitan areas of the binational border region?

Research question 4. Do north-south differences between the U.S. and Mexican border regions (comprising the 10-state border territory) resemble the north-south differences between the two sides of the U.S.-Mexico border twin cities?

Research questions 1. and 2. are based on prior literature (various chapters in Stoddard, 1983; Pick et al., 1987; Pick and Butler, 1994), that indicate major differences between north and south. U.S. and Mexican “border regions” in research question 1. refer to the respective 4-state and 6-state areas. Border strip in research question 2 is defined as the counties and municipios adjacent to the U.S.-Mexico border. Research question 3. is based on the authors’ observations about major metropolitan areas in the U.S. and Mexico. Research question 4. builds on research already conducted that compares selected twin cities on socioeconomic characteristics (Pick et al., 2000a,b, 2001b). Since that research found distinctive north-south differences for twin cities, this research question tests whether those differences also apply more broadly to the multi-state border regions.

4. Methodology—matching of characteristics

This research project utilizes a new design to construct a dual-census geographic information system (GIS) for the entire ten-state region of the U.S. and Mexico (Hettrick et al., 2000; Pick et al., 2000 c,d,e), including the county and municipio level, as well as the small area level for the eight border-adjacent twin cities. The region has previously lacked systematic dual-census GIS for the entire border region (north and south).

The system model is shown in Fig. 2. U.S. Census small attributes were converted and re-arranged into relational tables of a Microsoft Access data-base. Likewise, attribute data from the CIEN files of the Mexico Census of 1990 (INEGI, 1997) were converted and re-arranged into Microsoft Access relational tables. It was necessary to perform formula calculations to convert raw variables into finished ones, for instance, the project calculated “one-room housing” as the ratio of single bedroom housing units to all housing units. The formula computations for 16 matched variables were done in the Access scripting language (Hettrick et al., 2000).

The full set of sixteen matched variables are seen in Table 3. The table gives the matched definitions as well as formulas for computation. It was possible to fairly closely match all of them, with the exception of poverty. The details of definitional matching for fifteen of the variables are discussed elsewhere (see Pick et al., 2000a,b, 2001b). Poverty was more difficult to match exactly, since it does not have a standard definition according to the Mexican government and in particular Instituto Nacional de Estadística, Geografía, y Informática (INEGI), i.e. the Mexican Census bureau. We make an exception and included poverty, even though its definitions are not matched. We adopt the official definition for the
U.S. and a practical one of proportion of workers earning less than minimum wage for Mexico. The reason for allowing this exception is the importance of poverty as an indicator, but especially for Mexico, where it represents one of the most pressing national problems (Butler and Pick, 2001).

The variables were output with systematic geographic key fields. The key field is a unique identifier for each block group and AGEB. Following the formula computations, the Mexican and U.S. relational tables were merged and output as a file for input into ArcView GIS.
Table 3
Variable groups, matched variables and their definitions from Mexican and U.S. 1990 censuses

<table>
<thead>
<tr>
<th>Twin cities group and variable</th>
<th>Comparable definition—Mexican Census</th>
<th>Comparable definition—U.S. Census</th>
</tr>
</thead>
</table>

**Population variable group**
- **Population**
  - Dependency ratio: total population (pop less than 18 + pop 65 plus)/pop between 18 and 65
  - Gender ratio: male population/female population
- **Nativity**
  - Born in the state/total population
- **Immigration**
  - Population 5 plus resident outside the state in 1985/population 5 plus

**Social variable group**
- **Primary education**
  - Persons 15 plus with less than 9th grade education
- **Secondary education**
  - Persons who have attended high school 15 plus
- **Married**
  - Presently married population
- **Home ownership**
  - Ratio of owner occupied housing units to total housing units

**Economic variable group**
- **Economic activity**
  - Persons in the labor force/population
- **Unemployment**
  - Ratio of unemployed persons to total labor force
- **Underemployment**
  - Persons working 1 to 35 hours per week
- **Poverty**
  - Ratio of persons 18 to 64 below the poverty line, by official U.S. Census definition*

**Housing variable group**
- **One bedroom housing**
  - One-bedroom housing units/all housing units
- **Kitchen**
  - Housing units with complete kitchen facilities/all housing units
- **Public sewer**
  - Housing units with connection to public sewer/all housing units

* The official U.S. Census defines poverty by utilizing a group of monetary income thresholds which are varied by family size and composition. If a family is categorized as poor, then every person in the family is categorized as poor. The income thresholds are updated annually by the consumer price index and they do not vary geographically. The income threshold consists of before tax income that excludes capital gains and noncash benefits, such as medicaid and food stamps.

software. This output file contains a unified geographic key field that references the polygons in the binational coverage.

In another procedure, the U.S. Census small area boundary files were acquired from the GIS provider ESRI and the Mexican files from INEGI. The U.S. and Mexico border and its features were aligned utilizing the macro language and spatial commands of the advanced GIS software, ArcInfo. The alignment consisted of applying algorithms to modify the boundary files so the boundary edges conformed and the common features such as roads, rivers, etc. were joined at the border, in order to produce a two-nation boundary file that was seamless at the border (Hettrick et al., 2000). The result was output as a merged binational boundary file for input into ArcView (see Fig. 2). This merged boundary file contains the geographic key field to reference small area polygons in the U.S. and Mexico, as well as coordinates for the polygons that form the small areas. Finally, the merged binational attribute file and boundary file were ready for input into the ArcView GIS software, which joined the two files together for mapping based on the geographic key field.

The GIS system can utilize the dual-census data for spatial analysis and modeling, including cluster analysis to determine the urban structure of the twin cities (Pick et al., 2000a,b, 2001b). Further, an index of commonality was constructed based on the cluster analysis to determine the extent of similarity or difference between the U.S. and Mexican sides of the twin cities (Pick et al., 2000a,b, 2001a,b). These features are not discussed in the present paper, but the reader is referred to Pick et al., (2000a,b, 2001a,b).

The “dual-census” aspect of this GIS is similar to the information systems concept of “data warehouse.” A data warehouse is a very large data storage that emphasizes speed of access, multidimensionality, summarization, and flexibility/accessibility (Gray and Watson, 1998). We studied the question of whether the dual-census GIS for this project can be classified as a data warehouse and concluded is that yes, it largely meets the definition for data warehouse (Pick, Viswanathan, and Hettrick, 2000).

The dual-census design offers rich possibilities for analysis and modeling at the county and municipio levels. However, the present paper focuses on the descriptive spatial analysis of county/municipio patterns. In future research, short term forecasting models will be applied to project future values for small area units, for instance to predict land use, economic activity, or educational levels. Cluster modeling will be performed to determine binational areas that are similar or different. The dual-census aspect of the analysis opens up new realms for analysis and modeling, and offers enhanced capabilities for policy setting and decision making.

5. Findings: spatial analysis of U.S./Mexico borderlands counties and municipios

This section presents the findings from the spatial analysis for the sixteen matched characteristics. The section describes the most important aspects of the spatial patterns in order to answer the research questions. The discussion of results is organized by the four variable groups of population, social, economic, and housing. These groupings are commonly utilized in in social area analysis (Shevky and Williams, 1949, and numerous subsequent studies) and were utilized in a prior study of Mexico City (Pick and Butler, 1997).
They capture major aspects of urban areas, which is where most of the borderlands population lives. They have also been particularly relevant groupings for studying urban and city phenomenon in Mexico (Pick and Butler, 1997; Pick et al., 2000a,b). Later on, we return to answer the research questions and discuss the implications of the results.

5.1. Population group

Population represents the total population of a municipio or county. It is important to note that population of an area, such as a county, may be large or small and may not relate to the geographical size of the unit. In addition to population concentrations in the eight border twin cities, on the U.S. side there are the large population concentrations in southern California, Phoenix, Tucson, Denver, and the Texas cities of San Antonio, Austin, Dallas-Fort Worth, Amarillo, Corpus Christi, Houston, and Beaumont/Port Arthur (see Fig. 1). On the Mexican side, besides the eight border twin cities, population concentrations are evident in the city of Ensenada in Baja California, Hermosillo and Ciudad Obégón in Sonora, Chihuahua city in Chihuahua, Saltillo in southern Coahuila, the large city of Monterrey in Nuevo Leon, and Ciudad Victoria and Tampico/Ciudad Madero in southern Tamaulipas.

Some broad binational patterns are evident. The southern California metropolitan region is actually a binational megalopolis encompassing Tijuana and Ensenada. This populous area extends on the east towards Mexicali and then the large cities of Phoenix and Tucson. This large binational three-state metropolitan complex of southern California, Phoenix, and Tucson surrounds three less populated counties: Tecate in Mexico (1990 population of 51,557, Imperial County (pop. 109,303), and Yuma County, Arizona (pop. 106,895). Seen in this context, one can view those areas as susceptible to future growth. This growth actually took place in the 1990s in Imperial County, which was the most rapidly growing California county percentage-wide during that decade (Department of Finance, 2001). Another implication is that natural resources existing in these counties are being eyed by surrounding populous areas. For example, in the recent California energy crisis, the abundant energy in Mexicali and surplus of water in Imperial County are being viewed as potential sources by metropolitan southern California.

The least populated parts on the U.S. side are evident in eastern and northern Texas and in parts of Colorado in the southwest, west and northeast. There are vast unpopulated reaches in the north of Texas.

On the Mexican side, the most populous parts of the border region are Baja California, the southwestern coastline of Sonora, several cities in north and central Chihuahua, a two state area in southern Coahuila/western Nuevo Leon that includes Saltillo and Monterrey and northern and eastern Tamaulipas. The respective populations of Saltillo and Monterrey in 2000 were 577,352 and 3,236,604 respectively (INEGI, 2001). There is slight population in the deserts of interior Sonora in most of the mountainous interior of Chihuahua and in eastern Coahuila/northern Nuevo Leon. Overall, the coastal areas are more populous, while the dry interiors of Sonora, Chihuahua, eastern Texas, and northern Nuevo Leon are unpopulated.

Major population concentrations occur in the eight twin cities that stretch along the border from one end to the other (see Fig. 1). As seen in Table 2, they ranged in size in 1990 from 134,562 for the counties containing Eagle Pass, Texas, and Piedras Negras, Coahuila to 5.97
In contrast to population, dependency ratio is much higher throughout the Mexican border region compared to the U.S. border. Dependency ratio is the ratio of children (less than 18 years) plus old people (65 years plus) to the working age population (18–65). Since the Mexican borderlands population has a very low proportion of old persons, the extent of children rather than old people determines the numerator of the dependency ratio. In particular, the dependency ratio of the Mexican border region in 1990 was 0.784, which can be broken down further into the components of 0.716 children and 0.078 children. As seen in Fig. 3, in the Mexican border states, dependency ratio is highest in the southern and interior sections of the five border states other than Baja California. It is especially high in million for those of San Diego-Tijuana. The twin cities of El Paso-Ciudad Juárez, Eagle Pass-Piedras Negras, and Laredo-Nuevo Laredo are fairly isolated from other population centers, while the other twin cities are close to other large metropolitan areas. For instance, San Diego-Tijuana is close to Los Angeles.

Harsh environmental conditions and a general lack of population deficit in the central border area surrounding El Paso-Ciudad Juarez (population 2.40 million in 1990) explains why, for the 750 mile border stretch between Nogales-Nogales and Laredo-Nuevo Laredo, there is only one twin city of significant size.
southern Chihuahua, Nuevo Leon, and Tamaulipas, where it exceeds 1.10 i.e. there are 1.1 dependents for every person of working age. The reasons are that those areas are poor and have low education, intermediate attributes associated with high fertility.

The municipios directly adjacent to the border have quite variable dependency ratios. Municipios for the eight major twin cities have the lowest dependency ratios in the range of 0.75 to 0.90. However, the rest of the border strip has much higher dependency—in the range of 0.90 to 1.05. It is evident that the municipios containing the major border twin cities, as well as those containing major interior cities, are “islands” of low dependency ratio within the border states. This are several reasons for this: (1) their fertility is reduced, due to higher educational levels and greater prosperity; and (2) their working age population is larger, stemming from more productive economies and enlarged job opportunities.

On the U.S. side, the dependency ratio is lower than for Mexico. For the U.S. border region, the dependency ratio was 0.492 in 1990 (U.S. Census, 2001). In other words, the border region has twice as many workers as dependents. It can be further broken down into the components of 0.334 children and 0.158 elderly (U.S. Census, 2001). The dependency ratio is moderate in the large metropolitan counties. For example, the dependency ratio for San Diego County was 0.55; that for Maricopa County (Phoenix) was 0.63; and that for Bexar County (El Paso) was 0.64 (U.S. Census, 2001). Viewing the U.S. border strip from east to west, dependency ratios are higher in the southern Texas border than in the west. This is due to south Texas’s high fertility, which relates to low education and reduced access to family planning and public health resources.

Gender ratio, i.e. the ratio of males to females, varies substantially for the Mexican and U.S. border counties and municipios. In Mexico, it is much higher in the interior of the border states, except for Baja, which is somewhat below 1.00 throughout most of the state. In parts of the interior of the other five states, it exceeds 1.05, which connotes five percent more males than females. The most masculine municipios are in central and southeastern Sonora, south central and north central Chihuahua, northeast and northwest Coahuila, southern Nuevo Leon, and central and southern Tamaulipas.

In Mexico, gender ratios are lowest in the municipio containing Chihuahua city. Gender ratio is closely correlated with poverty. This may reflect that poorer Mexican families in the rural areas of the border region sometimes have lost women to the cities through employment in the maquiladora industry, whereas the men are retained and needed to provide rural income.

Nativity measures the proportion of the municipio population that was born in the state. Nativity in general is higher in the Mexican compared to the U.S. border region. This relates to a generally greater “rootedness” of the Mexico’s population, versus the U.S. (Pick and Butler, 1994).

It is evident on the Mexican side of the border that nativity is lower in the major border cities. Except for Baja California, the Mexican border cities tend to have about 10 to 15 percent lower nativity than the remainder of the states. For Baja, all four municipios are low in nativity. The twentieth century domestic internal immigration to the large Mexican border cities, that has fueled their demographic growth, has also contributed to lower their nativity. Another tendency is for nativity in Mexico to be lower in the western versus the eastern border. On the eastern border, the municipios containing the cities of Matamoros, Nuevo
Laredo, and Piedras Negras have low nativity, and that for Reynosa is very low. This reflects their rapid population growth, largely driven by immigration. In the western border, the border cities have even lower nativity, especially Ciudad Juárez, Mexicali, and Tijuana, which is less than sixty percent. The very low nativity for these three cities is directly tied to their rapid population growth from 1950–1990 (see Table 2), which averaged a startling 5.2 percent annually (INEGI, various years). The environments of binational interaction are influenced by the extent of nativity. Border cities having higher nativity, such as Nuevo Laredo, may be advantaged in establishing more stable, long-term binational planning or other relationships.

By contrast to the border cities, the southern interiors of Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas have high nativity in the range of 91 to nearly 100 percent. These areas, which are poor and have higher indigenous population, are very rooted, with strong family values and traditions. On the other hand, they may be affected by less mixing of cultures. These areas also ones are in physiographically rugged areas of deserts and mountains (Mueller, 1984). In many respects, these areas resemble impoverished ones in the south region of Mexico (see Pick and Butler, 1994).

The U.S. border in the west has very low nativity. For example the nativity in much of southern California, Arizona, and New Mexico is under sixty percent. These “Sunbelt” states grew through domestic internal migration during the last quarter of the twentieth century (see Fig. 4). During this period, they also experienced high inflows of international migrants, mostly from Mexico. Texas, by contrast, is more settled, as reflected in nativity in the range of 60 to 90 percent. The major exceptions of low nativity are the big cities of Austin, Houston, and Dallas-Fort Worth, all of which grew rapidly in the late twentieth century. The Texas border has lower nativity than the state as a whole, mostly under 70 percent. The major border cities of El Paso, Laredo, McAllen, and Brownsville are have even lower nativity. That reflects their rapid yearly growth rates during the 50s through 80s of 2.9 percent. Overall, Texas is a state of nativity contrasts, with its rooted interior contrasted with changing and growing large cities. In sum, the U.S. side has much lower nativity than for Mexico, with the exception of lower nativity in Baja and the border cities. Mexico’s border region is more “rooted.”

In-migration is a key attribute for the U.S.-Mexico borderlands. It has contributed as a component to rapid population growth in parts of the region, while leaving others in demographic stagnation. The attribute measures the proportion of county or municipio residents in 1990 who lived outside the state in 1985. Its impact goes beyond numbers—migrants into the border states also affects the values and culture of residents.

As seen in Fig. 4, immigration 1985 to 1990 was substantial to the border states of Baja California, California, Arizona and New Mexico. Counties in these states experienced immigration ratios in the range of 6 to 35 percent. Among the larger border cities, the Tijuana municipio’s immigration ratio was very high at 23 percent; San Diego County had a rate of 14 percent; while the Ciudad Juárez’ municipio’s rate was 12 percent. In these four border states, migration has been the major driver in their rapid population growth. In the Mexican border, the reasons for the domestic immigration are the attraction of the maquiladora industry and “step migration” to the border to await further movement into the U.S. (Butler and Pick, 1991). For the U.S. side, much of the migration can be ascribed to “Sunbelt”
migration i.e. a long-term national trend in the twentieth century of migration from the older and often economically declining parts of the northeast and midwest to states in the south and southwest.

By contrast, most of Texas’s counties had low to moderate migration ratios of 1 to 5 percent, in particular the more rural and less populated parts. On the other hand, high migration is evident for San Antonio, Austin, Dallas-Fort Worth, somewhat for Houston, and also from Amarillo northwards in the panhandle. Although high migration occurs for the county containing El Paso, it is less so for the south Texas border cities. Demographically, however, the south Texas cities’ moderate migration is offset through high fertility. Overall, Texas in the late 80s presents sharp internal migratory contrasts.

In Mexico, Baja California’s high immigration reflects Baja’s prominence as a destination for domestic migrants not only in the late 80s, but during the entire twentieth century (Butler and Pick, 1991). The municipio of Tijuana exemplifies this through its yearly growth rate of 6.1 percent from 1950–90 (see Table 2). Along the border strip, the municipios containing border cities mostly have high migration or, in the case of Nuevo Laredo and Matamoros, moderate migration.

The interiors of the Mexican border states largely have low inmigration, except the
metropolitan counties of Monterrey, the Pacific coast of Sonora, and the Atlantic coast of
Tamaulipas are moderate. In all, the Mexican borderlands exhibit huge contrasts for migra-
tion, between the entirety of Baja and the border cities (high), versus the unpopulated
southern interiors of other states (low).

5.2. Social status group

*Primary and secondary education* are significantly inversely related to each other. The
reason is that the primary education attribute measures the proportion of those who complete
primary school but went no further; whereas secondary education measures the proportion of
those who attended secondary school, but went no further. Only primary education will be
discussed in this paper, but the findings generally apply, inversely, to secondary education.

It is important to mention that culturally, primary education has different meanings in the
two nations. In the U.S. primary education is achieved by nearly 100 percent of the
population. Only a modest proportion, on the average, stop there i.e. do not proceed on to
attend secondary school or further. By contrast, in Mexico in 1990, the average educational
attainment was only fourth grade, and most of the population either attended or graduated
from primary school, but went no further (Butler, Pick, and Hettrick, 2001). As a result, the
proportion of primary-only education is much higher in the Mexican borderlands. For most
of the region, it ranges from 15 to 35 percent, while in the U.S. primary-only is mostly under
15 percent (see Fig. 5).

Along the Mexican border strip, primary-only is high and consistent. The Mexican
border-adjacent population has 20–35 percent primary education, with less than ten percent
going further. By comparison, in the south Texas counties adjacent to the border, primary
education predominates, in the range of 20 to 35 percent. In this part of the border, secondary
education ranges from 20 to 40 percent. Hence for the eastern half of the U.S.-Mexico
border, primary-only educational level or less prevails on both sides. Perhaps the most
remarkable aspect of this finding is the educational equivalency between the Texas border
counties and neighboring Mexican border counties to the south. This may appear puzzling
for a state that has famous public universities. The explanation is the following: the border
counties of Texas are among the poorest in the U.S., while the adjacent Mexican border
counties are well off by Mexican standards. Hence, there is a convergence in living
standards, including education.

In the western U.S. border, the primary-only ratios are mostly lower, in the range of 10
to 20 percent. Exceptions are the counties of Imperial and Nogales, with primary education
of over 20 percent. This reflects convergence with Mexico that resembles the situation
discussed for south Texas. Overall, the U.S. western borderlands to have a more advanced
educational profile, often exceeding the primary level, that contrasts with the primary-only
level in Mexico. The east to west U.S. differences mostly reflect deficiencies in the education
systems along the Texas border.

Although Mexico is a Catholic country that places high value on the family, in the border
region especially in the west, *marriage* rates are lower than for the U.S. This is especially
ture in Baja and Sonora, southeastern Chihuahua and southern Coahuila. The tendency for
lower marriage in the western border states versus the eastern ones reflects less traditional
marriage and higher extent of common law marriage (see Pick and Butler, 1994). Our variable is for traditional marriage and excludes common law marriage. In general, since the border is newer, more mobile, and less traditional, we can expect that traditional marriage norms will be weaker.

The World Fertility Survey of 1976–77 indicated that the proportion of women in common law marriages in the Mexican western border region ranged from 16 to 32 percent (cited in Pick and Butler, 1994). The low rates are especially evident in Sonora, for which mostly under 55 percent of population are married. Low marriage proportions also occur in the backward, rural areas of southeastern Chihuahua and southern Coahuila. Municipios containing border cities also have low proportion married (see Fig. 6). This may be due to their greater attraction to single persons, including maquiladora workers and to lower marriage rates generally in urban versus rural areas (Pick and Butler, 1994).

In the borderlands, U.S. marriage rates exceed those for Mexico. Within the U.S. border region, marriage rates are lowest in southern California, but still above Mexican levels. They rise somewhat in Arizona and New Mexico, and are highest in Texas often exceeding 70
percent, especially in the west, northwest and panhandle areas, which are more conservative. Marriage rates in south Texas tend to be lower, in the range of 57 to 63 percent, as well as for El Paso. Generally, the border twin cities on both sides have relatively low proportions married. This reflects the urban environment, with its less traditional settings, turnover of population, and larger migration flows.

Home ownership is sharply contrasted between the two sides. Mexico’s higher home ownership may be surprising at first. It reflects cultural differences, since throughout Mexico, more prosperous people tend to rent while the poorer ones own homes (Pick and Butler, 1994, 1997). One explanation is that mortgages in the U.S. sense are mostly not available in Mexico; hence a better-off person, who is seeking reduced payment increments, does it through a rental arrangement. By contrast, a poor person in Mexico can often acquire property just by claiming it, often illegally, in the peripheral parts of cities (Pick and Butler, 1997). In the U.S., middle class people seek home ownership, with heavy dependence on mortgages, whereas the less prosperous people are renters.

As a result of these factors, in the Mexican border region, there is a high level of home ownership, often exceeding 70 percent. The highest home ownership, at over 80 percent,
occurs in the interior central and southern parts of all the border states, with the exception of Baja. In these impoverished and often remote areas, rentals are not affordable, whereas free ejido land or "claiming property" are more common.

Richer Mexican border cities also have high rates of home ownership, often over two thirds. Tijuana municipio, for example, is somewhat lower with a home ownership ratio of 63 percent. In other work, we show that there is higher home ownership on the peripheries, versus the cities, of border cities (Pick et al., 2000a,b, 2001b).

The U.S. border region, by contrast, has lower rates of home ownership, generally at 50 to 65 percent. On both sides, the border-adjacent strip does not appear much different overall from the rest of the border, nor are there significant east-west differences. Rather, what is apparent for this variable is a sharp cultural contrast between the two nations, with different financial implications for renting and owning.

5.3. Economic group

Economic activity measures the ratio of the working age population to the whole population. It varies by many factors, including local and temporal economic conditions, age structure, and position of women in the labor force. It is higher overall in the U.S. borderlands, which reflects partly the older U.S. age structure. Also, the economic activity is somewhat lower in southern Texas. Among the highest economic activity in the entire region is San Diego County, which had economic activity of 53 percent in 1990. In fact, the entire coastal metropolitan area of southern California is high. In the U.S., economic activity is higher in the large cities, such as Phoenix, Austin, Houston, and Dallas. There is no consistent pattern along the border-adjacent U.S. counties, except that economic activity is highest in municipios containing the largest border cities of Tijuana and Ciudad Juarez, as well as those for the smaller cities of Nogales and Ciudad Acuño. It is high in the large city of Monterrey, and low in the impoverished central and southern parts of border states. The common theme on both sides is elevated economic activity level in the largest cities.

Unemployment is defined somewhat differently in the U.S. and Mexico (see article by Fleck and Sorrentino, 1994). This difference tends to result in lower unemployment rates in Mexico compared to the U.S. In addition, the U.S. border region is among the poorest in the nation, whereas the Mexican border region is generally better off than the rest of Mexico (Butler and Pick, 2001). Not surprisingly, there is a large contrast in unemployment between the two sides. On the U.S. side, there is a large zone of high unemployment in the south Texas counties near the border. For instance the border counties of Cameron (Matamoros), Hidalgo (McAllen), Webb (Nuevo Laredo), and Maverick (Eagle Pass) had unemployment rates in 1990 of 13.3, 14.3, 11.5, and 21.0 percent respectively. These areas are well known to be among the poorest in the U.S. (Time, 2001). El Paso's unemployment rate was 10.0 percent. The high border unemployment carries over to Nogales, Arizona, and Imperial County as well, which had unemployment rates of 10.0 and 14.3 percent. It is an irony that nearly all of the U.S. border twin cities in 1990 had high unemployment, in the midst of their rapid population growth and 20 years of maquiladora driven boom on the Mexican side. By contrast, the Mexican border cities had moderate to low unemployment. The discrepancy in the border cities of high unemployment in the U.S. juxtaposed with low unemployment in
Mexico limits the human and economic potential of these cities. The underlying reason for this is that the U.S. side of the twin cities, with the exception of San Diego, is dependent on the Mexican side for its more dynamic economy. The interiors of the Mexican border states had mostly low to medium unemployment, with patches of high unemployment in the far south.

Underemployment is defined nearly the same way in both countries. Throughout the borderlands on both sides, it tends to be high reaching levels of 28 to 48 percent in the interior and less prosperous parts of the border states. It is elevated in northern Arizona, eastern New Mexico, southern Chihuahua, and southwestern Coahuila, but low to moderate (under 24 percent) in major metropolitan areas. This is unsurprising, since it is easier to find full time jobs in those major job centers. In Mexico, underemployment has a wide range of variation—from over 40 percent in impacted areas to less than five percent in the Mexican border cities.

There is a striking difference in poverty between the eastern and western border (see Fig. 7). The eastern border has a high rate of poverty on both sides of the border, and especially so in the south Texas counties and for selected other Texas border counties. In the western border, the poverty rates are moderate, except for the elevated rate in Imperial County (22.2
percent in 1990). By contrast, poverty is very high in the southern parts of Chihuahua, Coahuila, and Nuevo Leon, and most of Tamaulipas.

Poverty also underscores the economic dilemma of the border: promise and maquila-driven economic growth along the Mexican border and harsh conditions in the middle and south of the Mexican border states, coupled with mostly adverse economic conditions along the U.S. border.

5.4. Housing group

Housing attributes are strikingly different on the two sides of the border, reflecting economic and cultural differences. Some of this contrast stems from contrasting construction standards: Mexicans utilize different materials and have different architectural standards than in America. The three attributes reflect these differences.

Access to a public sewer is much higher overall in the U.S. compared to Mexico (see Fig. 8). Rates in the U.S. range from 50 to 99 percent, while in Mexico, they vary from 5 to 80 percent. On both sides of the border, percent public sewer is highest in the major metropolitan areas, such as southern California, Phoenix, El Paso, Houston, Austin, Dallas, and for
Mexico in Ciudad Juárez, and Monterrey. Generally, on both sides of the border, this attribute parallels the relative prosperity of cities, towns, and people. For the border cities, the U.S. side has enhanced sewer ratios, versus Mexico. The variable serves as an indicator of the widespread infrastructure problem of the Mexican border cities and region (see Fernandez, 1983; Herzog, 1990; Time, 2001). That problem in turn reflects continual rapid demographic growth, without proportionate infrastructure investment.

The ratio of one room housing is balanced between the U.S. and Mexico. The one room housing is prevalent highest in southern Chihuahua and southeastern Tamaulipas. In the U.S. it is high in the southern Texas cities, but surprisingly it is high for the four counties stretching from San Diego to Nogales. It is unknown why the pattern of high extent of one bedroom housing occurs in the western border.

Ratio of separate kitchen is strikingly higher in the U.S. versus Mexico. In fact, it is the most distinctive, north and south, of the sixteen variables. The overall level of the attribute is about 30 percent higher in the U.S. On both sides, the attribute is highest in major metropolitan areas and lowest in rural ones.

6. Discussion: The research questions. Policy and planning implications of the spatial distribution of characteristics

This section of the paper addresses the research questions and pulls together the results of the spatial analysis for the four variable groups and 16 variables. It then looks at some of the policy and planning implications, as well as briefly indicating avenues for further research.

6.1. Research question 1. Are there substantial differences between the U.S. and Mexican border regions for the geographic patterns of 16 socioeconomic and demographic variables?

As seen in the summary in Table 4, the sixteen variables are predominantly different between the two sides. This highlights that for socioeconomic characteristics at the municipio and county level in 1990, there was not a merged “Amexica,” but distinctive north and south sections. An attribute that was similar between the two sides was population. Both sides have similar demographic patterns in the borderlands, consisting of a mixture of major metropolitan areas, large stretches of unpopulated interior rural areas, and border cities of significant size. Similar physiography and climate/resource constraints contribute to similar large-scale settlement and population patterns. Two economic attributes, underemployment and poverty, are also roughly similar on the two sides. Their near parity reflects the “convergence” (Dillman, 1983) in the respective border regions, i.e. the U.S. border region is poorer versus the U.S. remainder and the Mexican border region richer versus Mexico. The other economic attributes of economic activity and unemployment did not “converge.” That may reflect the strong structural effect of age structure on economic activity, and definitional differences for unemployment (Fleck and Sorrentino, 1993); and temporary shifts, and temporary differences for underemployment. By variable group, the differences are greatest
Table 4
Similarities and differences in borderlands, U.S. and Mexico, eastern and western border strips, 1990 censuses

<table>
<thead>
<tr>
<th>Twin cities group and variable</th>
<th>U.S.-Mexico border similarities and differences</th>
<th>Differences between Eastern and western border strip*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population variable group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>similar</td>
<td>For U.S. and Mex., pop. in E., center, and W. but not elsewhere</td>
</tr>
<tr>
<td>Dependency ratio</td>
<td>different, U.S. lower</td>
<td>none</td>
</tr>
<tr>
<td>Gender ratio</td>
<td>different, U.S. lower</td>
<td>none</td>
</tr>
<tr>
<td>Nativity</td>
<td>different, U.S. lower</td>
<td>For Mex., higher in rural border-adjacent municipios</td>
</tr>
<tr>
<td>Inmigration</td>
<td>different, U.S. has more widespread high areas</td>
<td>For U.S. and Mex., higher in W.</td>
</tr>
<tr>
<td><strong>Social variable group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary-only education</td>
<td>different, U.S. lower</td>
<td>For U.S., much higher in E. For Mex., somewhat higher in center</td>
</tr>
<tr>
<td>Secondary education</td>
<td>different, U.S. higher</td>
<td>none</td>
</tr>
<tr>
<td>Married</td>
<td>different, U.S. higher</td>
<td>none</td>
</tr>
<tr>
<td>Home ownership</td>
<td>different, U.S. lower</td>
<td>none</td>
</tr>
<tr>
<td><strong>Economic variable group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic activity</td>
<td>different, U.S. higher</td>
<td>none</td>
</tr>
<tr>
<td>Unemployment</td>
<td>different, U.S. higher</td>
<td>For U.S., highest in E. (S. Texas)</td>
</tr>
<tr>
<td>Underemployment</td>
<td>roughly equal but variegated</td>
<td>none</td>
</tr>
<tr>
<td>Poverty</td>
<td>roughly equal but variegated</td>
<td>For U.S., much higher in E. (S. Texas). For Mexico, much lower in W.</td>
</tr>
<tr>
<td><strong>Housing variable group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One bedroom housing</td>
<td>different, U.S. higher</td>
<td>none</td>
</tr>
<tr>
<td>Kitchen</td>
<td>different, U.S. higher</td>
<td>For U.S., much higher in W.</td>
</tr>
<tr>
<td>Public sewer</td>
<td>different, U.S. higher</td>
<td>none</td>
</tr>
</tbody>
</table>

* The border strip consists of countries and municipios adjacent to the U.S.-Mexico border.

for housing, social, and some economic characteristics, and somewhat less for the population group.

Overall, the research question is supported—that there are substantial north-south differences in geographical patterns between the north and south border regions for the variable set.

6.2. Research question 2. Are there substantial differences between the eastern and western border strips of the U.S. and Mexico for the geographic patterns of 16 socioeconomic and demographic variables?

The findings indicate that about half of the attributes have substantial east to west differences along the border strip. Hence the research question is partially supported. The variables with east to west differences along the U.S. border strip are population, immigration, primary-only education, unemployment, poverty, and separate kitchen. Population and immigration are closely linked together and reflect the western versus eastern border as a more attractive U.S. domestic migration destination, leading in turn to larger populations. The education difference stems from well documented weaknesses in the Texas educational
systems along the border strip. Although the state took some steps in the 90s to redress the border’s educational disparity, the 1990 data did not reflect this. Likewise, the economic adversities of the south Texas border area are the major cause of east-west differences in unemployment and poverty. The difference in separate kitchen reflects the greater presence in the eastern border on the U.S. side of “colonias” and other housing that more closely resembles Mexico’s, whereas in the western U.S. border this variable approximates U.S. standards. The east to west differences along the Mexican border strip are greatest between Baja-northeast-Sonora and the rest of the border. For many attributes, Baja-northeast-Sonora tends to wealthier, more mobile, better educated and better housed than the remaining border strip to the east.

About half of the characteristics are similar east to west, leading to the conclusion of partial support for the research question.

### 6.3. Research question 3. Are there significant differences on 16 socioeconomic and demographic characteristics between the major metropolitan areas and other, non-major metropolitan areas of the binational border region?

As seen in Table 5, this research question is mostly supported. Those characteristics that differentiate major metropolitan areas (U.S. or Mexican) from other areas are higher population, lower dependency ratio, higher proportion of women, lower nativity, higher immigra-

<table>
<thead>
<tr>
<th>Twin cities group and variable</th>
<th>Major metropolitan (MM) versus non-major-metropolitan (NMM) areas</th>
<th>Differences in border cities (N.-S.) versus border regions (N.-S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population variable group</strong></td>
<td>Populations: MM higher, NMM lower.</td>
<td>Different, BC higher</td>
</tr>
<tr>
<td>Dependency ratio</td>
<td>MM lower</td>
<td>Similar</td>
</tr>
<tr>
<td>Gender ratio</td>
<td>MM lower (Mex. side only)</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Nativiy</td>
<td>MM lower</td>
<td>Similar</td>
</tr>
<tr>
<td>Immigration</td>
<td>MM higher</td>
<td>Similar</td>
</tr>
<tr>
<td><strong>Social variable group</strong></td>
<td>Primary-only education: Inconsistent</td>
<td>Similar, except reversed in S. Texas</td>
</tr>
<tr>
<td>Secondary education</td>
<td>MM higher</td>
<td>Similar</td>
</tr>
<tr>
<td>Married</td>
<td>Inconsistent</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Home ownership</td>
<td>Similar</td>
<td>Similar</td>
</tr>
<tr>
<td><strong>Economic variable group</strong></td>
<td>Economic activity: MM higher</td>
<td>Similar</td>
</tr>
<tr>
<td>Unemployment</td>
<td>Inconsistent</td>
<td>Different, U.S. higher</td>
</tr>
<tr>
<td>Underemployment</td>
<td>Inconsistent</td>
<td>Different, U.S. higher</td>
</tr>
<tr>
<td>Poverty</td>
<td>MM lower, except higher in Texas border</td>
<td>Different, U.S. higher</td>
</tr>
<tr>
<td><strong>Housing variable group</strong></td>
<td>One bedroom housing: MM higher (U.S. side only)</td>
<td>Similar</td>
</tr>
<tr>
<td>Kitchen</td>
<td>MM higher (U.S. side only)</td>
<td>Similar</td>
</tr>
<tr>
<td>Public sewer</td>
<td>MM higher (U.S. side only)</td>
<td>Similar</td>
</tr>
</tbody>
</table>
tion, more high school educated, higher economic activity, lower poverty, and improved housing characteristics. These metropolitan characteristics apply regardless of whether the large metro area is located in the U.S. or Mexico. Inconsistencies are mostly based on disparities of economic structure between the two countries. Research question 3. results correspond to findings for the metropolitan characteristics of Mexico City compared to the rest of Mexico (Pick and Butler, 1997).

6.4. Research question 4. Do north-south differences between the U.S. and Mexican broad border regions (comprising the 10-state border territory) resemble the north-south differences between the two sides of the U.S.-Mexico border twin cities?

Research question 4 is mostly supported (see Table 5). The main divergence from the research question is for population. In particular, Baja California populations are relatively higher for the cities than the region. This stems from Baja California having such a high proportion of population in border cities. There are differences in three economic characteristics between the regions (N./S.) and the cities (N./S.). In each case, the cities had relatively higher values for the U.S., compared to rough parity for the regions. This may stem from the U.S. border cities being better off than U.S. border rural areas. For the other variables, comparable similarities/differences of north to south exist, whether for the cities or regions.

6.5. Policy implications

The substantial north-south differences in the geographic patterns of these characteristics implies that binational policy and planning relevant to them must be done differently on the two sides. Joint efforts at setting policy and planning will falter, if the ground rules for the two nations are set identically. Differences need to be recognized. An example is housing, for which this paper has shown large differences in levels and spatial patterns. Binational policy setting must recognize the differences and not attempt an equivalent policy for the two sides.

The partially-present differences in the border strip from east to west are important for policy setting and planning of particular attributes. For instance, border-wide policies can be set for issues involving home ownership, without being concerned about east-west sub-areas. However, for primary education, the large differences east to west along the 2000 mile border implies setting separate policies and plans for sub-regions. The fact that metro areas are different from non-metro areas in these characteristics is important for understanding the border region. For instance, for some characteristics, planning may be more consistent between Tijuana, Ciudad Juárez, San Diego, and El Paso as a group of cities than between the Mexican border twin cities as a group, or the U.S. border cities as a group.

Another planning implication stems from distinctive patterns in the border regions of domestic inmigrat.ion. Although international migration has garnered much of the media coverage in recent years, internal migration has varied a lot in the border and influenced the long term growth or stagnation of border sub-areas. Although not discussed in this paper, the origin of domestic migration streams influences the demographic characteristics and socio-
cultural changes at the destination points. For instance, prior research has shown that most of the domestic immigration to Baja California in the twentieth century came from central-western Mexican and especially from the state of Jalisco (Butler and Pick, 1991). Thus the characteristics of Jalisco (demographic, social) are being reflected in Baja California. Since different parts of the border receive varied migrant streams, the receiving areas are being influenced. This in turn may influence policy and planning.

Regarding specific attributes, several stand out as particularly important in border policy setting. Education is particularly important for planning, since it points to the future generations of border inhabitants. The north south differences accentuate that in many respects the concept of “Amexica” is not robust. Rather, the U.S. maintains a strong overall advantage in education. One indicator of this advantage is a tendency in some border twin cities for Mexican families to deposit children with relatives families on the U.S. side in order to attend U.S. schools. However, the exception to this disparity is in south Texas, where the advantage disappears and the educational north-south education levels are similar. Binational educational policy setting and planning would be different in south Texas-northeastern Mexico, versus the rest of the border.

The sharp economic differences north and south noted for border cities (Pick et al., 2000a,b, 2001a) does not hold true for the long-term trait of poverty. Poverty ranges from high to low in particular zones on both sides of the border. For instance, on the U.S. side there is high poverty in south Texas, while the Mexican border has high poverty in “pockets” in the south of inland border states. Lower poverty on both sides is evident in large metropolitan areas, Mexican border cities, and the states of California and Baja California. Both federal governments have set goals lower or eliminate poverty, so enhanced understanding of poverty’s specific patterns on both sides will enable better targeting of how to reduce it in the borderlands.

Finally, this research points to the significance for policy makers and planners to consider the broad border region. Over the past decade, the news media in both nations has focused on the border cities. The reason relates to the border cities’ prominent role in NAFTA, the maquiladora industry, and the unwholesome areas including crime and drugs. Often ignored are the large reaches of rural and sometimes physically harsh areas in both nations. However, those areas also have trends and patterns that need to be better understood by government planners. For instance, the harsh, isolated, and impoverished rural areas in the central and southern parts of the Mexican border region need further research and more attention by policy makers.

The present research has attempted to describe and summarize major patterns and contrasts for the larger binational border region. Future research using multivariate modeling of border phenomenon for the enlarged region will answer particular questions. The border region’s counties and municipios should be further studied based on the full set of attribute information from the two nations’ censuses of 2000, which should be available by the middle of 2002. It is important not only to study the levels and patterns of attributes in 2000, but also what the increments of change were from 1990 to 2000.

Another type of future investigation that would be helpful is to in-depth study of particular binational zones of the border. For instance, south Texas-northeastern Mexico would be
important to study as a more specific binational region, as well as the large binational, megalopolis of southern California, Tijuana, and Mexicali.

7. Conclusion

Demographic and socioeconomic patterns of distribution for sixteen attributes were examined for 519 municipios and counties in the U.S.-Mexico border region. The methods consisted of data-base and spatial analysis software and tools. Attributes were matched between the censuses of 1990 for the U.S. and Mexico. A binational GIS was established that included matched boundaries and data-bases. Descriptive analysis was performed of the patterns followed by summarization of overall findings. Major findings are the following:

1. The geographical patterns were different north and south for the sixteen variables, with the exceptions of population, underemployment, and poverty. The two sides of the broad border region are seen to be sharply contrasted for most attributes.
2. The geographical patterns for some attributes did not change from the eastern to the western border strip. However, for about half of the attributes there was substantial change on one side or the other. For instance, poverty on the U.S. side is much higher in the eastern than in the western border.
3. Major metropolitan areas throughout the binational border region differ from the non-metropolitan areas in the levels and patterns of sixteen variables. In particular, the non-metropolitan areas have higher population, lower dependency ratio, higher proportion of women, lower nativity, higher immigration, more high school educated, higher economic activity, lower poverty, and improved housing characteristics.
4. The north-south differences at the municipio-county level are largely the same to those at the border city level. The main area of disparity is for several economic variables, which have more accentuated differences at the county/municipio level, as compared to the twin city level.
5. Policy and planning can be informed by the results of this study. This is especially true as regards educational disparities, understanding domestic (versus international) immigration flows, identifying the sharp binational differences in housing and certain economic attributes, and understanding that some of the metropolitan-non-metropolitan differences may be stronger than north-south ones. Policy-makers and planners should sometimes consider the 2000 mile border as an integrated whole, but other times should plan for sub-areas within this region.
6. This study can be expanded in future research through multivariate modeling, study of 2000 census data when available, and by more intensive study of binational sub-regions, some evident in the present research.

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References


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