The Maquiladora's Changing Geography

By Jesus Cañas and Robert W. Gilmer

A lack of data has limited our understanding of the distribution of maquiladora activity. Recently, Mexico's chief statistical agency provided previously unpublished information that will allow us to draw a more detailed portrait.

The role of the Mexican maquiladora has changed greatly in recent years, but the basics remain the same. The typical plant is foreign owned and engaged in labor-intensive assembly of intermediate or final goods.[1] The vast majority of inputs are brought from the U.S. or another country, and the output is usually sold in the U.S.

Maquiladoras are an extension into Mexico of U.S. production of automobiles, electronics, apparel and many other goods. They're a major engine of growth in cities along the U.S.–Mexico border, where the plants are concentrated. Economic benefits spill into neighboring U.S. cities, creating jobs in manufacturing, warehousing, transportation, logistics, real estate services and major border protection programs.[2]

These general characteristics are well known, but a lack of data has limited our understanding of the distribution of maquiladora activity. Recently, the Instituto Nacional de Estadística y Geografía (INEGI), Mexico's chief statistical agency, provided previously unpublished information that will allow us to draw a more detailed portrait of an industry that employs 1.2 million workers, accounting for about a third of Mexico's manufacturing jobs.[3]

We take a preliminary look at where specific maquiladora activities take place within Mexico. Then we examine changes in location since 1990, finding that the North American Free Trade Agreement (NAFTA) and other trade pacts have been the most important factors reshaping patterns of maquiladora employment.

Maquiladora Location and Activity

Mexico created the Border Industrialization Program in 1965 to promote maquiladoras, initially restricting plants to a 20-kilometer-deep strip along the U.S.–Mexico border. The original maquiladora cities were Matamoros, Juárez, Nuevo Laredo and Tijuana. Mexico relaxed location restrictions in the early 1970s, allowing the program to expand into the interior, except for such congested and highly industrialized regions as Monterrey and Mexico City. All restrictions disappeared by the early 1990s.

The INEGI data allow us to profile maquiladora activity for 1990, 2000 and 2006, showing the percentage of employment by city and region, based on total hours worked. The year 2000 marked the division between a long period of virtually uninterrupted industry expansion and a period of much slower job growth or even decline.

The slowdown started with the U.S. recession in 2001. The slump converged with potent foreign competition from China, the Caribbean and elsewhere to cut maquiladora employment by 298,000 jobs, or 22.1 percent, in 17 months.

As the industry evolved, it became apparent that permanent job losses were concentrated in the lowest-skill, lowest-wage sectors. With the maquiladora industry shifting to higher-wage, higher-productivity operations, the pace of recovery fell back on Mexico's long-standing competitive advantages, such as proximity to the U.S., an experienced and skilled workforce and a stable political system.[4]

INEGI has tracked 17 principal maquiladora cities for many years. They made up 78.4 percent of maquiladora hours worked in 1990 but only 66.4 percent by 2000 and 67.9 percent in 2006 (*Table 1*).

Eleven of the 17 cities are on the U.S.–Mexico border, and their collective employment share went from 70.3 percent in 1990 to 56.7 percent by 2000 and 61.1 percent by 2006. For the six cities on the Texas–Mexico border, the combined share of maquiladora employment fell from 45.6 percent in 1990 to 38.4 percent in 2006. Juárez's share of maquiladora work has fallen since 1990, but it remains the No. 1 employer among the 17 cities. Gaining share, Reynosa has risen to third; losing share, Matamoros has sunk to fifth. In 2006, California border cities Tijuana at 13.8 percent and Mexicali at 4.6 per-

Table 1

Maquiladora Employment Patterns Shifting

	Share of total hours worked			Employment*
	1990	2000	2006	2006
17 principal cities	78.4	66.4	67.9	837,828
Other cities	21.6	33.6	32.1	396,471
Border cities	70.3	56.7	61.1	753,846
Texas border	45.6	33.0	38.4	474,434
California border	18.9	20.0	19.2	236,968
Arizona border	5.8	3.7	3.4	42,398
Interior cities	8.1	9.7	6.8	83,982
Border interior	7.0	7.2	6.4	79,276
Distant interior	1.1	2.5	.4	4,706
Texas border cities				
Juárez	25.1	17.9	20.6	253,937
Reynosa	5.3	5.1	8.3	101,882
Matamoros	7.4	4.7	4.4	54,208
Acuña	3.2	2.4	2.6	32,579
Nuevo Laredo	3.0	1.7	1.8	22,036
Piedras Negras	1.6	1.1	.8	9,774
Nation	100	100	100	1,234,299

*Full-time-equivalent employment, based on annual hours worked per city, divided by annual hours per employee. Annual hours per employee is based on 44 hours a week and a standard vacation and holiday schedule.

NOTE: Numbers may not total due to rounding.

SOURCES: Instituto Nacional de Estadística y Geografía; authors' calculations.

cent filled the No. 2 and No. 4 positions.[5]

What do maquiladoras produce by city? Juárez was always an important center for automobile-related parts and components, and Tijuana specialized in consumer and business electronics. However, the new INEGI data offer a broader look at the distribution of maquiladora activity by sector.[6]

For the 17 cities, we looked at the two largest sectors in 1990 and 2006 and found evidence of greater geographical diversity. On average, the largest sector accounted for 44.2 percent of employment in 1990 and 38.8 percent in 2006. The top two sectors totaled 67.3 percent of employment in 1990 and 62.1 percent in 2006.[7]

In both 1990 and 2006, three sectors dominated activity on the Texas border—electronics, transportation equipment and electrical machinery (*Table 2*). This holds on a broader scale as well; one of these three sectors was the largest in 12 of the 17 principal cities in 1990 and 13 of them in 2006. And one was the No. 2 sector in 10 cities in both years.

On the Texas border, output in electronics and electrical machinery is more closely related to auto parts. Most electronics maquiladoras on the California border are under Asian ownership and make products for the home, such as televisions and CD players, or for businesses, such as printers and copiers.

Exceptions to the top three sectors appear in several places—for example, the furniture sector helps explain the size of the wood and metal products category on the California border in 1990. Services can range from call centers or coupon processing to sophisticated engineering and testing. The catchall "other manufacturing" category has grown in recent years as a result of diversifying maquiladora activities and the inability to fit some activities neatly in an aging industrial classification system.

Textiles and apparel appears as a dominant sector in three cities in 1990 but only in Torreón in 2006. However, the sector is the largest in the "other cities" category in both 1990 and 2006—a fact explained by the industry move to nonmaquiladora cities in Mexico's interior.

Trade Deals as Catalyst

Well-known factors drive the overall growth of the maquiladora industry—among them, the U.S. industrial sector's performance, exchange rates, access to U.S. markets and competition from low-wage nations. As we examine the industry's changing location within Mexico, it becomes clear that two other factors are important—geography and trade policy.

First, some sectors had already selected cities based on location. Auto suppliers wanted the best access to the U.S. heartland and often chose cities on the Texas border. Consumer electronics firms needed access to Asian suppliers, making California cities a logical choice. The apparel sector opted for the lower wages of central Mexico.

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These historical patterns linked many cities' performance to specific sectors.

Second, changing trade rules determined the relative success of specific sectors. The past 25 years have seen rapid trade liberalization as Mexico turned away from the strong protectionist policies of the 1980s. NAFTA in 1994, the Caribbean Basin Trade Partnership Act of 2000, the end of the Multifibre Arrangement (MFA) in 2005 and competition from low-wage Asian labor followed, bringing shifting international forces.

The maquiladora industry's sensitivity to the trade agreements is logical. Dating to the 1960s, these operations were an early example of how multinational companies could use cross-border production sharing to reduce wage costs. In Mexico, the location of these plants is often based on short-term and local advantages, and their ties to the community and its suppliers are few.

Three large maquiladora sectors—textiles and apparel, electronics and transportation equipment—stand out when measuring the extent to which trade-related regulations influence location (*Table 3*). We look at these sectors by the distribution of employment across regions in 1990, 2000 and 2006, and by annual percentage growth rates from 1990 to 2000 and 2000 to 2006.

The broad slowdown between periods isn't peculiar to these sectors; it results from cyclical and structural factors common to the maquiladora industry. What matters as we look for changes in location are the differences in these sectors' growth rates within each period—reading across rows, rather than comparing columns. The regional winners show faster growth or smaller declines. The relative losers grow more slowly or fall off by larger amounts.

Textiles and apparel. NAFTA opened a window for dramatic expansion of Mexican textiles and apparel—including maquiladoras in this sector.[8] Before the trade pact took effect in 1994, the model for most U.S. clothing companies involved producing and cutting fabric in the U.S., exporting it for sewing and finishing and re-importing the final product.

Strict quotas limited each country's re-imports, keeping apparel activity spread across a number of nations. NAFTA gave Mexican apparel decisive advantages by allowing duty-free entry into the U.S. if all components from the thread forward were of NAFTA origin. The pact also relaxed or eliminated many quotas.

Mexico's cutting and sewing sector boomed as companies shifted operations from around the world to take advantage of access to the large North American market. Hours worked in textile and apparel maquiladoras expanded 22.9 percent a year between 1990 and 2000.

New trade initiatives slowly dismantled the edge NAFTA gave Mexican apparel exports. The Caribbean Basin trade initiative expanded U.S. market access to 24 low-wage countries throughout the Caribbean and Central America.

The final blow came in January 2005 with the phase-out of the MFA, a pact that had sharply limited U.S. textile and apparel imports from India, China, Bangladesh and other low-cost Asian countries. Employment in Mexican apparel maquiladoras fell at an 8.2 percent annual rate after 2000.

Once Mexico lost the NAFTA and MFA

Table 2
Key Sectoral Changes in Maquiladora Cities
(Hours worked)

	Largest sector 1990	Percent share	Largest sector 2006	Percent share
17 principal cities	Electronics	29.2	Electronics	25.8
Other cities	Textiles and apparel	21.9	Textiles and apparel	37.0
Border cities				
Texas border	Transportation equipment	28.1	Transportation equipment	31.7
California border	Electronics	36.0	Electronics	26.1
Arizona border	Electronics	54.0	Electronics	45.6
Texas border cities				
Juárez	Electronics	31.1	Transportation equipment	34.8
Reynosa	Electrical machinery	50.7	Electronics	26.0
Matamoros	Transportation equipment	32.6	Transportation equipment	31.6
Acuña	Transportation equipment	29.8	Transportation equipment	57.5
Nuevo Laredo	Transportation equipment	31.7	Transportation equipment	40.0
Piedras Negras	Textiles and apparel	39.2	Electrical machinery	36.0
Interior cities				
Border interior	Transportation equipment	42.7	Transportation equipment	33.2
Distant interior	Electronics	26.1	Electronics	26.0
Nation	Electronics	26.1	Electronics	22.2
	Second-largest sector 1990	**Percent share**	**Second-largest sector 2006**	**Percent share**
17 principal cities	Transportation equipment	22.0	Transportation equipment	23.7
Other cities	Other manufacturing	17.1	Transportation equipment	17.3
Border cities				
Texas border	Electronics	24.7	Electronics	24.7
California border	Wood and metal products	15.5	Other manufacturing	20.4
Arizona border	Other manufacturing	14.7	Other manufacturing	28.2
Texas border cities				
Juárez	Transportation equipment	29.7	Electronics	27.4
Reynosa	Transportation equipment	18.0	Transportation equipment	15.5
Matamoros	Electrical machinery	28.7	Electronics	24.6
Acuña	Services	16.6	Electrical machinery	11.6
Nuevo Laredo	Other manufacturing	25.2	Other manufacturing	28.4
Piedras Negras	Food processing	20.2	Electronics	23.6
Interior cities				
Border interior	Electronics	27.1	Electronics	21.0
Distant interior	Electrical machinery	25.7	Services	18.8
Nation	Transportation equipment	20.8	Transportation equipment	21.6

SOURCES: Instituto Nacional de Estadística y Geografía; authors' calculations.

preferences, the sector sought cities where producers could lower costs. Central Mexico was home to the traditional Mexican apparel sector, with few maquiladoras, but foreign plants opened to take advantage of the region's experienced workers and significantly lower wages.

In 1990, plants along the Texas, California and Arizona borders accounted for 43.5 percent of maquiladora apparel production. By 2006, 82.7 percent of the apparel maquiladora activity was in smaller cities away from the border.

Electronics. Fueled by the tech boom, maquiladora employment on the California border expanded at a 15.1 percent annual rate from 1990 to 2000, making this area the electronic sector's fastest-growing location.

The expansion occurred despite restrictions imposed by NAFTA's Article 303, which required Mexico to charge duties on non-NAFTA inputs entering the country. Mexico responded with 20 sectoral programs that selectively lowered tariffs on inputs that were heavily supplied from Asia. This kept the electronics sector moving forward through 2000.

Trends reversed after 2000, and the California border became the second-fastest shrinking region, with employment falling at an 8 percent annual rate. Increasing Chinese competition had a lot to do with it.

The value of a Mexican location was low-tariff access to U.S. markets. China's entry into the World Trade Organization in 2001, however, lowered tariffs on China's U.S. shipments. Production for the U.S. market shifted from Mexico to China. In effect, China's lower wages in many cases trumped Mexico's proximity to the U.S.

Transportation equipment. Autos dominate transportation equipment maquiladoras. In the 1980s maquiladora-produced parts and components were mostly exported to U.S. assembly plants. As early as 1989, however, the Mexican government was actively encouraging maquiladoras to become suppliers to Mexico's own assembly operations, then protected by high tariff walls.

In the 1990s, NAFTA created a single, continentwide market for auto assembly and parts production. Integration and restructuring has been extensive—and complex to the point of bewilderment—but the new rules encouraged Mexico's auto-assembly sector to expand. Since 2000, new and modern plants spread across northern and central Mexico have produced about 2 million autos a year.

Until 2000, the 17 principal cities accounted for more than 80 percent of sector employment. The Texas border was at more than 60 percent. The sector's border concentration resulted from the historical need to ship parts quickly and cheaply to plants in the U.S. Midwest.

The parts and components segment remains concentrated on the border, and its primary focus remains U.S. assembly operations. However, the post-NAFTA expansion of the Mexican auto sector opened new markets. Maquiladora suppliers are following the modern assembly plants into nontraditional cities such as Guanajuato, Saltillo, Hermosillo, Silao and Aguascalientes.

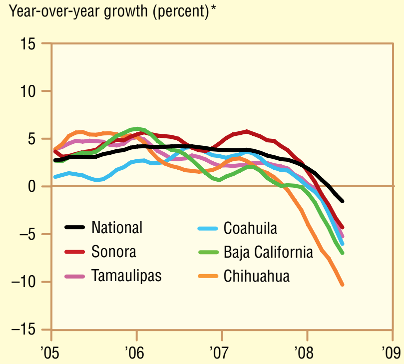
Since 2000, transportation equipment sector employment has shifted toward nontraditional maquiladora cities, where employment has grown at a 10.6 percent annual rate, compared with no change in

Table 3
Trade Agreements' Impact on Three Sectors
(Hours worked)

Textiles and apparel	Percent share			Annual percent growth	
	1990	2000	2006	1990–2000	2000–06
17 principal cities	53.9	20.5	17.8	11.6	–10.4
Border cities					
Texas border	27.8	5.9	4.6	5.3	–11.8
California border	9.7	3.7	5.2	11.5	–2.8
Arizona border	6.0	.8	1.3	.9	–1.3
Interior cities					
Border interior	8.5	6.1	6.2	19.1	–8.0
Distant interior	1.9	4.0	.5	32.0	–35.4
Other cities	46.1	79.5	82.2	29.8	–7.7
Nation	100	100	100	22.9	–8.2
Electronics	**Percent share**			**Annual percent growth**	
	1990	2000	2006	1990–2000	2000–06
17 principal cities	87.9	80.8	78.9	12.8	–4.3
Border cities					
Texas border	41.5	37.5	42.7	12.6	–1.8
California border	26.1	29.2	22.6	15.1	–8.0
Arizona border	11.9	6.5	7.1	7.0	–2.5
Interior cities					
Border interior	7.2	6.9	6.1	13.3	–6.1
Distant interior	1.1	.6	.4	7.6	–9.5
Other cities	12.1	19.2	21.1	19.2	–2.4
Nation	100	100	100	13.8	–3.9
Transportation equipment	**Percent share**			**Annual percent growth**	
	1990	2000	2006	1990–2000	2000–06
17 principal cities	83.1	84.2	74.4	12.1	0
Border cities					
Texas border	61.8	62.9	56.4	12.1	.3
California border	3.6	5.3	6.2	16.3	4.8
Arizona border	3.3	2.7	1.7	10.0	–5.8
Interior cities					
Border interior	14.3	13.1	9.8	10.9	–2.6
Distant interior	.2	.2	.3	15.5	5.3
Other cities	16.9	15.8	25.6	11.2	10.6
Nation	100	100	100	11.9	2.1

SOURCES: Instituto Nacional de Estadística y Geografía; authors' calculations.

Chart 1
Job Loss in Mexico Border States Outstrips National Decline



*Three-month moving average.
SOURCES: Instituto Mexicano del Seguro Social; authors' calculations.

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the traditional locations and a 0.3 percent gain on the Texas border.

Recession and the Border States

Maquiladoras on the U.S.–Mexico border were quickly drawn into the collapse of U.S. manufacturing in late 2008, which heavily affected the automobile and consumer electronics sectors.

Ripples from maquiladora shutdowns quickly spread, bringing rapid and steep declines in formal-sector employment in northern Mexico's five maquiladora border states.[9] In each, maquiladoras are the dominant factor in manufacturing, and manufacturing is a very large, if not dominant, segment of formal employment.

The result has been 12-month employment declines through February that rival the losses of the 2001 recession, with Chihuahua down 10.4 percent, Baja California 7 percent, Coahuila 6.1 percent, Tamaulipas 5.3 percent and Sonora 4.4 percent (*Chart 1*). The figures far outstrip the 1.6 percent decline for all of Mexico over the same period.

These job losses are reminders that Mexico's maquiladora industry remains closely tied to the U.S. economy. At the same time, the country's embrace of freer trade has exposed the industry to the vicissitudes of the marketplace, bringing important shifts in maquiladora employment. We can anticipate further changes in maquiladora geography.

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Notes

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[1] "Maquiladora Data: Mexican Reform Clouds View of Key Industry," by Jesus Cañas and Robert W. Gilmer, Federal Reserve Bank of Dallas *Southwest Economy*, no. 3, 2007.

[2] It has been estimated that a 10 percent increase in maquiladora output in a Mexican border city can generate a 1 to 2 percent increment in employment in the adjacent American city. "U.S.–Mexico Integration and Regional Economies: Evidence from Border-City Pairs," by Gordon H. Hanson, *Journal of Urban Economics*, vol. 50, no. 2, 2001, pp. 259–87.

[3] INEGI performs statistical work comparable to that done in the U.S. by the Census Bureau, Bureau of Labor and Statistics and Bureau of Economic Analysis.

[4] "Maquiladora Recovery: Lessons for the Future," by Jesus Cañas, Roberto Coronado and Robert W. Gilmer, Federal Reserve Bank of Dallas *Southwest Economy*, no. 2, 2007.

[5] The California border cities are Tijuana, Mexicali and Tecate; the Arizona border cities are Nogales and Agua Prieta; the border interior cities, located near the border but not on it, are Monterrey, Guadalupe, Torreón and Chihuahua; the interior cities are the two largest urban areas, Guadalajara and Mexico City, including the surrounding state of Mexico. The "other cities" category is computed by subtracting the sum of the 17 principal cities' employment from the national total.

[6] The specific sectors tracked by INEGI and their percent shares of 2006 maquiladora employment: electronics (22.2), transportation equipment (21.6), other manufacturing (15), textiles and apparel (14.4), electrical machinery (10.4), wood and metal products (5.1), services (4.4), chemicals (2.9), nonelectrical machinery (1.8), food processing (0.9), toys and sporting goods (0.6) and shoes and leather (0.5). The definitions are not comparable to classification systems used for broader application, such as the national income accounts.

[7] One reason for plants' attachment to a specific location in Mexico may be economies of agglomeration. Large concentrations of plants in a city can lower the cost of operations by providing skill-specific labor, an industry knowledge loop and a solid supplier base.

[8] See "Boom and Bust: Is It the End of Mexico's Maquiladoras?" by John Sargent and Linda Matthews, *Business Horizons*, vol. 46, no. 2, 2003, pp. 57–64; "NAFTA, Trade Diversion and Mexico's Textiles and Apparel Boom and Bust," by William C. Gruben, Federal Reserve Bank of Dallas *Southwest Economy*, no. 5, 2006; and "Causes of Growth and Decline in Mexico's Maquiladora Apparel Sector," by Mehrene Larudee, *International Review of Applied Economics*, vol. 21, no. 4, 2007, pp. 539–59.

[9] Formal-sector jobs are those subject to minimum wage and pension guarantees and other legal protection.