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Abstract: Policy makers that view export processing zones (EPZs) as a useful development initiative frequently argue that while low wages and tax incentives may be needed to attract investment in a newly created zone, over time participating firms will evolve towards a higher value added, technology intensive production model. Once this stage is reached, the expectation is EPZ firms will be able to support a higher cost structure yet still view the host country as an attractive production location. Based on data collected from 55 maquiladoras employing more than 67,000 people, we identify the reasons why transnational companies continue to produce in a mature, higher cost zone. Rather than the ability to use advanced technology, our sample firms remain in Mexico because it allows them to meet the needs of demanding North American customers that are willing to pay a higher price for non-standardized products. With technology appearing to be more of a generic commodity than previous research would suggest, we conclude by examining the policy implications of this study for Mexico as well as other developing countries that have incorporated EPZs as an integral component of their development strategy.

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1. INTRODUCTION

In order to spark economic growth, countries throughout the developing world have established export processing zones (EPZs). Through making available to transnational corporations (TNCs) a low wage workforce and offering various investment incentives, host country governments in Latin America, Asia, Eastern Europe and elsewhere compete to attract export oriented firms (ILO, 1998). Always controversial, even after 25 plus years of debate there are still questions regarding the usefulness of EPZs as an economic development initiative (cf. Grunwald and Flamm, 1985; Sklair, 1993; Johansson and Nilsson, 1997; Buitelaar and Pérez, 2000; Ver Beek, 2001; Mortimore, 2003). For example, EPZ critics argue if wage rates increase and tax breaks are reduced in one country, EPZ firms will simply close down and move to another zone where wages remain low and the incentive package is more generous (Kaplinsky, 1993). EPZ advocates, in contrast, commonly take the position that while early entrants into a zone tend to be concentrated in low value added activities, as an area gains industrial experience EPZ firms will transition towards a higher value added, technology intensive manufacturing paradigm. Once this stage is reached, the explicitly stated or implied assumption is TNC investment will continue to flow into the zone, wages will go up, and participating firms can begin to pay their "fair share" of taxes. After all, where else would these companies go? Even with higher costs, wage rates in a mature zone are still far below those in industrialized countries and the ability to efficiently manufacture complex products is thought to be possible only in a limited number of locations in the developing world.

Based on plant visits and interviews with top managers at 55 firms employing over 67,000 people in two major industrial centers in Mexico, in this study we examine the question of what happens in a mature, technologically advanced EPZ when the total costs incurred by zone firms increase. Mexico's EPZ initiative, commonly referred to as the maquiladoras or simply maquilas, represents an

ideal location to examine this research question. With its origins dating back to 1965, beginning in the late 1980s a steady stream of research has found maquilas have transitioned toward a more technology intensive, higher valued added production model. For example, Carrillo and Hualde (1998) state the industry is now composed of three generations; first generation maquiladoras dedicated to low value added assembly, second generation firms performing manufacturing operations, and third generation maquiladoras where such activities as design engineering and research and development (R&D) are combined with manufacturing and assembly. Recent studies also find that maquilas are forming highly productive industrial clusters (Carrillo & Hualde, 2002) and taking on "full-package" production responsibilities (Bair & Gereffi, 2001).

With these advancements, it would seem that maquiladoras would be well-positioned to remain the preferred location for exporters serving the US market even if costs are higher than in other major EPZs. Unfortunately, this does not appear to be the case. With job losses approaching 300,000, beginning in November, 2000 and continuing into 2003 the maquiladora industry has experienced a severe contraction. Scholars attribute this to a number of factors (cf. Carrillo & Gomis, 2003); i.e. the demand for maquiladora outputs in the US has been somewhat unsteady, the costs associated with producing in Mexico have increased, and there are new trade benefits available to firms supplying US markets from EPZ locations in Asia and the Caribbean Basin. The performance of the maquiladora industry since 2000, therefore, provides strong evidence that even in a mature, technologically advanced EPZ, an increase in relative costs will result in significant job losses. Going beyond the macro-economic evidence, however, a number of important questions remain.

Within the development literature (cf. Lall, 1990; Global Competitiveness Report 2001 – 2002; Gereffi, 2003), climbing up the technological ladder into higher value added, more complex industrial

activities is thought to be one of the keys to sustainable competitiveness and wealth creation in the developing world. This position is also pervasive in much of the maquiladora literature. For example, Gerber and Carrillo (2003; 291) argue the more technologically advanced the maquiladora, the more likely it is to survive the 2000 – 2003 downturn. They write "Third generation maquiladoras have a competitive advantage when compared to second and especially first generation plants due to their greater ability to engage in product and process innovation, to more effectively utilize administrative techniques, and to compete based on product quality."

In this study, we examine the role of technology as well as other factors as an explanation for the continued survival of EPZ firms in higher cost areas. Our findings are not entirely consistent with research that directly links technological advancement with EPZ competitiveness. The parent companies of the great majority of our sample firms have manufacturing facilities in other low wage countries. As a general rule, these TNCs choose to produce in their higher cost Mexican plants not due to the technological demands of the manufacturing process but rather as a response to customer requirements. Concisely stated, the maquiladora option allows firms serving North American markets to supply final assemblers on a just-in-time (JIT) basis, to respond rapidly to shifting consumer demand, to provide customized rather than standardized products, and to minimize transportation costs for hard to ship items.

This article is organized as follows. Section Two provides a brief summary of the recent performance of the maquiladoras paying particular attention to the dynamics resulting in higher costs for participating firms. We also outline the shift in trade regimes that have increased the relative attractiveness of EPZ programs in Asia and Central America when compared to Mexico. Section Three contains a summary of our research methodology and sample firms. In Section Four we present

our results and in Section Five we examine the policy implications of this study for Mexico as well as other developing countries that have incorporated EPZs as an integral component of their development strategy.

2. MAQUILADORAS AND RELATIVE COSTS

The maquiladora industry experienced steady growth during its first three decades. By January, 1994, total employment stood at 546,433 (INEGI, 2003). Facilitated by a rapidly growing US economy (the destination for more than 95 percent of maquila exports) and the devaluation of the Mexican peso in late 1994, the industry experienced double digit growth rates throughout the mid to late 1990s. By October, 2000 maquila employment reached an impressive 1,347,803. Not only did the industry provide new jobs, but the quality of maquila production systems also improved. As mentioned, for the last 15 plus years maquila researchers have documented the growth of higher value added, technology intensive forms of maquiladora production (cf. Gereffi, 1992; 2003; Wilson, 1992; Shaiken, 1990; 1994; Carrillo & Hualde, 2002). Studies also find maquiladoras in segments such as auto parts and electronics offer employees the opportunity to develop valuable industrial skills (Sargent & Matthews, 1997; Hualde, 2001). The characteristics of the maquila workforce has also changed. Traditionally retaining primarily a female workforce, by 2002 maquilas employed more men than women (INEGI, 2003). The maquiladora contraction beginning in November, 2000 came as a surprise to many in the industry. As shown in Table One, employment dropped sharply in five of the six largest maquiladora centers and in two of the three primary maquila segments. The most obvious explanation for this decline can be traced to the 2001 recession in the US.

Table One: *Changes in Maquila Employment by City and Sector from 01/1994 to 09/2003*

	01/1994	10/2000	09/2003	Job Losses
City				
Cd. Juárez	129,991	264,241	197,000	73,350
Tijuana	80,506	199,428	143,489	58,461
Reynosa	34,874	67,275	72,564	< 5,018 >
Matamoros	39,126	69,989	52,684	17,745
Mexicali	19,495	65,494	50,597	13,847
Cd. Chihuahua	28,336	53,319	43,953	10,993
Sector				
Electronic	190,940	467,508	328,088	139,420
Auto Parts	126,061	250,635	236,145	14,490
Apparel	67,269	293,576	200,287	93,289
Industry Total	546,433	1,347,803	1,056,553	291,250

Source: INEGI, Banco de Información Económico, Industria Maquiladora de Exportación

Since many Mexican EPZ firms produce intermediate products that are then exported to the US, economists tend to treat maquiladoras as an extension of US industry (Gruben, 2001; Fullerton & Schauer, 2001). When US industrial production falls, as it did in 2001 and 2002 (by 3.4 and .6 percent respectively), it is expected maquiladora exports and employment will also suffer. At the same time, the 2001-2003 contraction is unprecedented and few maquila specialists believe all of the industry's troubles can be traced to the US economy. In the literature, there is agreement regarding the additional factors contributing to the industry's contraction (Gerber & Carrillo, 2003; Carrillo & Gomis, 2003; Sargent & Matthews, 2003; GAO, 2003). These include:

1. <u>The appreciation of the Mexican peso and Mexican wage rates</u> - In 1998, the average dollar/peso exchange rate was 1/ 9.152. Five years later in 2002, the exchange rate had barely

changed (1/9.663). However, total accumulated inflation during this period was 12 percent in the US but 60 percent in Mexico. The fact the Mexican peso did not devalue in a proportion equivalent to the differences in inflation contributed to a substantial increase in the wage and other peso denominated costs for maquiladoras that tend to earn revenue in dollars. Measured in US dollars, Christman (2003) found the average hourly wage of direct labor, technical, and administrative personnel (including fringe benefits) paid by maquiladoras increased from $1.88 in 1998 to $2.67 in 2002.

2. Changes in the way maquiladoras are taxed - Beginning in the mid-1990s the Mexican government has pursued an aggressive policy designed to increase the tax revenues flowing to the central government from EPZ firms (Sargent & Matthews, 2001; Schatan, 2002). These changes include increases in both payroll and corporate income taxes (through modifications in the transfer pricing rules) and threats to impose a tax structure enabling the Mexican government to collect taxes on the final sale of maquila produced goods in the US.

3. The implementation of NAFTA Article 303 - In a regional free trade agreement such as NAFTA, there is an incentive for firms to import non-regional products through the country with the lowest external tariff (Sargent & Matthews, 2001). In order to discourage this practice, beginning in 2001 NAFTA requires the Mexican government to charge duties on maquiladora imports from non-NAFTA countries. To provide duty relief for the EPZ sector, the Mexican government introduced a series of sectoral programs lowering Mexican duties for most but certainly not all maquiladora non-regional inputs to the zero to five percent range. For plants utilizing products now subject to Mexican duties, Article 303 has increased the costs associated with Mexican production.

4. Changes in the trade regime applicable to US apparel imports - NAFTA resulted in the elimination of duties as well as highly restrictive US import quotas for apparel producers in the region

(Gereffi, 2003). Producers in other countries now or will in the near future enjoy similar benefits as a result of both the recently implemented Caribbean Basin Economic Recovery Act and the elimination of apparel quotas in 2005 as required by the latest World Trade Organization (WTO) sponsored trade agreement (Rodrigues-Archila, 2000). As a result of quota elimination, in 1999 the US International Trade Commission estimated that China's share of US apparel imports would jump from 12 to 30 percent (USITC, 1999). By 2003, Chinese exports accounted for 17.6 percent of US apparel imports while Mexico's share has fallen from 13 percent in 2000 to an estimated 10.1 percent in 2003 (see Table Two for additional trade comparisons).

5. The growth of China's export economy - China's ascension to full membership in the WTO in 2001 and the growth of Chinese exports to the US represents a serious threat to Mexico's maquiladoras not only in apparel but in other key industries as well (Watkins, 2002). As shown in Table Two, over the 2000 to 2003 period Mexican exports have fallen in both the apparel and electronics sectors while Chinese exports of these products have increased rapidly. When compared to Mexico, the Chinese competitive advantage is based on more than just lower wages but also in the cost and quality of raw and intermediate inputs and the generous incentives given by the Chinese government. Taken together, the information presented in this section indicates the Mexican EPZ industry has undergone at least two major changes over the last several years. First, maquiladoras have experienced widespread upgrading into more technology intensive, higher value added sectors. Second, total production costs in Mexico have gone up at the same time the comparative advantage of utilizing EPZs in lower cost areas has increased. In the next section, we discuss the research methodology we employed to identify the maquiladora response to these new competitive conditions.

Table Two: *US Imports 2000 – 2003 from Mexico, China, and Central America (in millions of US dollars)*

Total US Imports from Mexico and China

	2000	2001	2002	2003
Mexico	134,734.4	130,508.9	134,121.2	137,199.3
China	99,580.5	102,069.3	124,795.7	151,620.1

Electrical machinery and equipment (Tariff Headings 85, 8471, 8473)

	2000	2001	2002	2003
Mexico	44,401.4	43,493.6	41,325.6	40,274.6
China	29,361.9	29,543.4	38,526.7	50,164.7

Apparel (Tariff Headings 61 and 62)

	2000	2001	2002	2003
Mexico	8,617.0	8,027.0	7,638.3	7,098.0
China	6,192.9	6,416.0	7,069.9	8,666.7
Honduras	2,415.0	2,437.0	2,502.4	2,568.3
El Salvador	1,600.2	1,633.8	1,675.1	1,719.6
Guatemala	1,484.5	1,615.1	1,659.5	1,761.7
Nicaragua	337.3	380.2	433.8	483.8

Source: United States International Trade Commission (http://dataweb.usitc.gov)

3. DATA SOURCES AND METHODOLOGY

(a) Sample firms

For this study we conducted plant visits and in-depth semi-structured interviews with top managers at 55 plants located in two major Mexican export centers. Our primary research site was the city of Reynosa. Located on the US-Mexican border across from McAllen, Texas, as of September,

2003 Reynosa (72,564) ranked behind only Cd. Juárez (197,000) and Tijuana (143,489) as the Mexican city with the largest number of maquila employees. Reynosa represents a particularly interesting location since it is the only major maquila center that has not experienced significant job losses since November, 2000. With the exception of apparel, Reynosa firms are well diversified in the major maquila segments and are controlled by a mixture of both large and small corporations from the US, Europe, and Asia. Utilizing a directory provided by a local economic development agency, we contacted maquiladoras located in the six major industrial parks in Reynosa that had started operations in 2001 or earlier and employed 125 or more people. Managers at 50 of the 75 firms that fit our sampling criteria agreed to participate. Interviews were conducted from July to November, 2002 and from August to September, 2003.

In order to gain a broader perspective, in June, 2003 we conducted plant visits and managerial interviews in Guadalajara, Jalisco. Often referred to as Mexico's Silicon Valley, especially during the late 1990s Guadalajara became a significant center for electronics manufacturing. From $1.6 billion in 1994, in 2000 companies in Guadalajara exported more than $10 billion dollars of electronic products (CADELEC, 2003). We conducted interviews at five of the city's primary TNCs that collectively employed over 20,000 people. In contrast to the growth present in Reynosa, employment in the Guadalajara electronics cluster has fallen precipitously. For example, it had been widely reported in the local business press both the local IBM and Hewlett Packard plants had lost their most important production lines (lap top computers and printers respectively) and a long list of companies (such as Motorola, NEC, On Semiconductor, and Celestica) had closed plants in the area (Orihuela, 2003a). In addition, the president of the local maquiladora association reported that employment in member firms had dropped from between 40,000 to 45,000 people in 2001 to 28,000 by 2003 (Orihuela, 2003b).

Table Three: *Sample Characteristics*

	Industry Sector			***Parent Nationality***			**Grand**
	Electronic	**Auto**	**Other**	**US**	**Asia**	**Europe**	**Total**
Reynosa							
Number of firms	21	9	20	41	3	6	50
Total employment	20,801	17,508	8,440	38,367	2,286	6,096	46,749
Guadalajara							
Number of firms	4	0	1	4	1	0	5
Total employment	17,535	0	2,800	12,335	8,000	0	20,335
Total							
Number of firms	25	9	21	45	4	6	55
Total employment	38,336	17,508	11,240	50,702	10,286	6,096	67,084

(b) Survey Questions

Within our sample, 33 plants (representing 88 percent of total sample employees) are controlled by TNCs with manufacturing plants not only in Mexico but also in low cost countries in both Asia and Eastern Europe. In addition, 9 plants are controlled by TNCs with owned facilities in one other low cost region, 5 are controlled by parents with formal outsourcing relationships with Asian suppliers, and only 8 maquilas are controlled by companies with operations only in the US and Mexico (respectively these three categories represent 4.1, 4.6, and 3.3 percent of total sample employees). Given the great majority of especially large firms in our sample have extensive operations in lower cost countries, for them to continue to produce in Mexico there clearly needs to be a compelling reason to do so. To identify this "compelling reason," we asked our interviewees a series of questions such as the nature of the parent company's production network, the role played by the Mexican EPZ plant(s) within the

parent's manufacturing strategy, how this role had changed over time, and whether any of the factors that contributed to a rising cost structure in Mexico altered what the parent company was planning to do in Mexico. We also inquired whether they were competing against firms making the same products that have plants in China or in other low wage, developing country locations. If the answer was yes, we asked how the parent company's strategy was being affected by the sourcing strategy adopted by competing firms. In addition, we included questions addressing other dynamics such as the evolution of the local production system, the use of technology, the responsibilities of the on-site engineering teams, and the development of the skills and abilities of the Mexican workforce.

4. RESULTS

(a) Reynosa

Rather than adopting a pre-determined classification scheme designed to determine why firms produce in a higher cost EPZ, we first carried out the data collection phase of this study. With this inductive approach, we attempted to identify commonalities in the explanations provided by our interviewees for why the firms they represent continue to produce in Mexico. What became clear by the end of the data collection process was parent company sourcing networks and the nature of the competitive threats these firms face in US markets fall into three general categories. In addition, these market dynamics appear directly related to the strategies adopted by our sample firms. First, some maquilas face direct competition from manufacturers located in lower cost countries (almost always China). We classify these firms as competing in global markets. A second group compete within what we label mixed global/regional markets. In this category, standardized, low cost, "off the shelf" items sold in the US are being produced in lower cost areas. However, within the parent company the

Mexican plants are being used to produce non-standardized goods. We divided our sample firms in this category into a number of subcategories corresponding to the strategies firms have adopted in order to successfully compete in non-standardized segments. Finally, the third category of maquiladoras are those competing in regional markets. For a variety of reasons, these firms face little if any direct competition from companies located in lower cost countries. We also identified a number of subcategories for firms in this grouping. Utilizing firm profiles as well as other information, in the remainder of this section we provide additional details regarding these categorizations and their relationship to maquila strategy and success.

(i) Maquiladoras competing in global markets

Standardized product, low cost producers (8 firms, 3,972 employees) - As mentioned, maquiladoras competing in global markets face direct competition in the US from producers located in lower cost countries. For example, Profile Maquila One is owned by a US company that produces and distributes a wide product line to retail operations in the US. Within the parent company's internal sourcing network, highly automated lines are located in the US. Reynosa is the only plant in the division located outside the US and is used to produce items requiring some hand labor. With the range of products sold by the division, less than half are actually manufactured internally and the rest purchased from outside vendors (often located in Taiwan or China). Over the last year employment has dropped by roughly 50 people. In addition, they had just lost one of their main lines to a Chinese supplier. The plant manager stated the parent company was saving a half million dollars per year by switching to Chinese sourcing. When asked what the plant would be doing in the future, he replied "Less."

Of the eight firms in this category, six indicated they faced critical near term competitive threats. One plant shut down operations during the study period as the parent company began purchasing

exclusively from Chinese suppliers. Another plant lost four of its five production lines to China. At a third maquila, the plant manager stated it was a poorly kept secret that corporate was going to close down the Mexican plant and move to China. Top management at another plant decided to withdraw from the US retail market and to redirect their sales efforts to Latin America. Only three of their five production lines were operating at the time of our interview.

(ii) Maquiladoras competing in mixed global/regional markets

The primary characteristic of firms competing in mixed markets is the production of standardized goods requiring long production runs has been conceded to producers in China and other lower cost countries. To survive, Mexican EPZ firms have adopted a variety of "high mix, low volume" approaches. In other words, a plant which may have thrived when costs in Mexico were lower following a "low mix, high volume" strategy (i.e. producing relatively few items but in great volume) are now assembling or manufacturing multiple products and product lines but with relatively low volumes. We identified three subcategories of this "high mix, low volume" business model as well as two other strategies for firms in this category.

Corporate shelters (8 firms, 8,733 employees) - Firms pursuing a corporate shelter strategy establish a maquiladora and support staff. Then, working with parent company product divisions and/or manufacturing facilities in higher cost areas, managers identify processes capable of being profitably transferred to Mexico. Typical of this business model, Profile Maquila Two is owned by a large TNC with extensive global operations. Facing intense cost pressure, the parent company still has a number of plants in the US. However, many of the US production lines that might make sense to transfer to a lower cost country do not have sufficient volume to justify establishing a stand alone facility. At the Reynosa shelter, and under the direction of a plant manager with experience running similar operations in

India and Eastern Europe, a product division can rent factory space, start small, and experiment with EPZ style production. Once the division learns what they are doing, the goal is to grow the business and perhaps even get to the point where it makes sense to move out of the shelter and establish their own plant. At the time of our interview, three different divisions had relocated production lines to the Reynosa shelter. The plant manager stated they are specializing in products the customer needs with a 24 to 72 hour lead time that cannot be supplied through inventory. By the end of the study period, the shelter had added more than 300 employees, a fourth division had moved in, and they were planning to expand.

In addition to the corporate shelter strategy, other firms were pursuing a closely related contract manufacturing model. In other words, rather than operate in Mexico the divisions simply contract with the Mexican maquila. In either case, the plants look the same; i.e. they specialize in a wide variety of often low volume products that are then sent to multiple divisions within the parent company. At one maquiladora, the CEO had sent a strong message to the division presidents that they needed to move manufacturing out of the US into either Mexico or China. As a result, five divisions with very different product lines were now operating in two buildings in Reynosa and the maquila had added 600 employees over the last two years. After a number of plants had been closed in the US and Mexico and the work transferred to Reynosa, another plant manager stated that they now manufactured or assembled over 50 unique product lines. In the contract manufacturing model, plant managers often have to actively market their services to the plant managers and division vice presidents in the US. One Reynosa manager stated he visits the nine plants the parent company has in the US at least once every two years. His goal with these trips is to identify processes that can be profitably transferred to Reynosa and then convince top management at those locations to move the work to the border.

Dual sourcing (5 firms, 4,100 employees) - Firms pursuing a dual sourcing strategy have plants producing similar goods in Mexico and in another, lower cost country (typically China). As an example, Profile Maquila Three is owned by a large TNC that manufactures a wide range of consumer products and has EPZ facilities in Mexico, China, and Eastern Europe. With a number of products, they follow a "dual tooled" strategy. For example, the company may estimate North American annual demand for a product to be 1.5 million units. However, demand could easily vary from 1.2 to 1.7 million units. From their lower cost Chinese plants, shipped by sea it takes roughly six weeks for goods to go from the factory to their clients' US distribution centers. In contrast, from Reynosa products can be manufactured and sent to those same distribution centers in a matter of days. If their Chinese plant is the sole source and demand in the US suddenly drops, the parent company will have six weeks worth of what has suddenly become excess inventory coming across the Pacific. Also, if demand jumps it will again take at least six weeks to fully respond. To improve response time, the Chinese plant may be assigned to manufacture one million units and Reynosa will be used to produce anything above that number. Using this dual sourcing approach, the parent company can take advantage of lower costs in China yet still keep inventories low and respond in a matter of days rather than months to the frequent rush orders placed by their very large, powerful, and unforgiving customers (retailers such as Wal-Mart and Home Depot).

Mass customization (5 firms, 2,998 employees) - Firms in this category are moving towards a strategy of providing made to order products requiring short delivery times to North American consumers. To illustrate, Profile Maquila Four is owned by a large and rapidly growing TNC with production operations in a variety of countries including China. Responsible for supplying markets throughout the Americas, the Reynosa plant employed over 1,000 people at the time of our interview.

Originally specializing in low end goods, the plant now manufactures some of the parent company's most innovative products. As for why they supply the Americas region from Reynosa rather than China, our interviewee stated there is tremendous variation with their products; they deal with three standard protocols and a number of different color and configuration options. Furthermore, their average order size had dropped by 50 percent and wholesale customers are looking to get rid of their distribution centers. He stated it is becoming increasingly common for a retail outlet in the US to receive an order, then fax the plant, and they will Fed Ex the item to the customer the same day. To increase the flexibility of their production systems (and thereby quickly adjust production to match customer orders), they are moving from having dedicated production lines to more manufacturing cells, regularly moving operators between cells, using more hand labor ("operators are more flexible than machines"), and planning to hire more temporary workers to deal with seasonal as well as monthly demand fluctuations. As a result of these and other innovations, they are approaching their all time production record, producing three times the number of models, and employing 200 fewer people than they were a year ago. In addition, their total cost to produce an item has gone down by 20 percent.

Other maquila strategies in mixed global/regional markets - We identified two additional generic strategies within this mixed market category. The first (6 firms, 1,678 employees) are highly specialized suppliers of intermediate products whose competitive advantage is based on being close to North American industrial customers. These maquiladoras typically did not directly compete against lower cost producers for sales in North America. However, several of their primary industrial customers had recently moved from North America to China and as a result a number of plants in this subcategory suffered a drop in sales. The final group (3 firms, 1,670 employees) is composed of recently established maquiladoras controlled by parent companies, or divisions of parent companies,

that have no prior international experience. The dominant characteristic of these plants is their struggle to learn as quickly as possible what it takes to be successful in Mexico. As a result of start up challenges, at two of the plants the initial plant manager was fired. At the third, the division vice president lost his job. With these three maquilas, producing in China was viewed as a possible option in the medium term especially if the parent company began to experience significant cost pressures in US markets. However, the companies clearly needed to first learn how to operate in Mexico before attempting to establish additional plants in other overseas locations.

(iii) Maquiladoras competing in regional markets

The primary characteristic of maquiladoras in this category is they do not face competition in North American markets from producers located in lower cost countries. We identified four sub-categories within this grouping.

Just-in-time (JIT) producers (6 firms, 16,623 employees) - As clearly stated by our interviewees, final assembly facilities in North America controlled by GM, Ford, DaimlerChrysler and to a lesser extent Asian and other European auto firms all require their first and second tier suppliers ship to them on a JIT basis. Given the difficulties in utilizing this approach from geographically distant locations, none of our interviewees at the larger auto part producers in Reynosa stated they faced direct competition from Asian firms in North American markets. With a very competitive cost structure when compared to the US and Canada, Reynosa auto part producers appeared to be doing very well. At Profile Maquila Five, our interviewee indicated they are the highest volume as well as the most capital intensive manufacturing site within the parent company system. He stated Reynosa is "still the facility of choice" and "All the new technology will continue to come down here." Furthermore, he stated the company's CEO recently visited and other top corporate executives are always touring the Reynosa

plants because "They know their big salaries and bonuses come from here." The parent company is expanding their presence in China. However, these plants are used to supply the Asian market. Due to their technological sophistication, the fact they had been able to do "marvelous things with productivity," and "our customers are expecting instantaneous deliveries," he did not foresee parent company facilities in Asia being used to supply North American markets for at least 10 to 15 years ("Maybe").

Zero defect producers (4 firms, 2,440 employees) - These maquilas compete in industries such as medical products, aviation, aerospace, and even defense. The defining characteristic of these firms is if the product they make fails, the end user or users may be injured or even killed. As explained by the plant manager at Profile Maquila Six, they compete on the basis of product quality and features and not on cost (their average gross margin is almost 60 percent). As for quality, their defect rate is only one part for every ten thousand produced and our interviewee stated "I still lose sleep over it." Approximately 10 years ago the parent company set up a business unit in China to supply lower end items. However, the plant manager stated their products frequently undergo design changes. With the extended supply chains characteristic of Chinese production, they were not able to make those changes fast enough. The parent company eventually closed down the Chinese business unit and began emphasizing Mexico as a low cost alternative. Although the plant experienced problems during start up, under the direction of a new plant manager with extensive maquila experience over the last two years facility utilization jumped from 48 to 105 percent, they added 350 new jobs, and recently Reynosa was recognized as the top ranked plant within the parent company's manufacturing network.

Low value to weight producers (3 firms, 2,310 employees) - As implied by the subcategory title, these maquilas produce relatively inexpensive, heavy items. As stated by our interviewee at Profile Maquila Seven, in their division there are plants performing similar activities in Reynosa and at two US

locations. Utilizing very capital intensive but relatively low tech processes, Reynosa is the volume plant while the ups and downs in demand are absorbed by the US plants. They do not face Chinese competition in US markets. However, they exported to Asia until the parent company set up a similar facility in China. In addition to weight, the plant manager stated he did not foresee Chinese plants being used to supply North American markets because there would be too much inventory in the pipeline and their customers often do not know what they really want. From Reynosa they can fill an order in 24 to 36 hours. In addition, they had improved their on-time delivery rate to 96 percent. Their primary competitor in US markets has a plant in another city on the US-Mexican border. Employment in Reynosa has increased steadily and they expect to add at least another 200 jobs in the next two years.

Remanufacturing centers (2 firms, 2,225 employees) - These firms focus on repairing defective items. As for their basic business model, typically there is a product that no longer works (often under warranty) that has been returned to the manufacturer. The company then has a choice; they can either throw it away or attempt to repair it. If it is more economical to repair, and since it rarely makes sense to ship the item from the US to a geographically distant country such as China and then back again, compared to other options in North America Mexico may represent an ideal low cost repair location. Originally established by a company with production facilities in the Far East, Profile Maquila Eight had encountered a number of problems. A new generation of low cost products broke down less frequently and in many cases were then simply thrown away. With low factory utilization ("They made the plant too big"), the plant was sold to a contract manufacturer. In addition to performing the repair work for the original owner, the new operator has been able to attract a flood of new business from companies looking to outsource their own remanufacturing operations.

(b) Third generation maquiladoras and the Reynosa cluster

Given the research of authors such as Carrillo and Hualde (1998) and Gerber and Carrillo (2003) regarding the emergence of maquiladoras performing R&D and design engineering activities, we paid special attention to the role assumed by engineering departments within our sample firms. In addition to determining if they were performing these "third generation" functions, we asked our interviewees to describe the strategic role played by local engineering groups. In total, 3.8 percent of our sample employees are working in some kind of engineering capacity. In addition, our interviewees at 10 maquiladoras stated they were performing design engineering and/or new product development functions. At four of the ten, however, the products made and the design work performed were both relatively straightforward. Reflecting this lack of complexity, the percentage of engineers to total employees at these plants (1.8 percent) is considerably less than the same ratio for the full sample.

Local design engineering teams did play a much more important role at five plants (all competing in mixed global/regional markets). For example, at a maquiladora pursing a dual sourcing strategy the parent company had designated Reynosa as a "secondary design center." As explained by the plant manager, in the parent company system there are seven distinct stages to take a new product from a concrete idea (Milestone One) to bulk production (Milestone Seven). In the past, it was customary for US based teams to take a product through the majority of these stages. However, Reynosa is now assigned products from Milestone Four onward. With this change, the US design teams can now introduce four new products a year rather than the customary two. Following a similar pattern, at a plant pursuing a mass customization strategy our interviewee stated Reynosa engineers are now assigned to specific products from product inception at the centralized design groups in the US and Europe to "product death." By having local engineering involved earlier, they reduced the time it takes to set up a new production line from two months to two weeks. At one of the start-up maquiladoras, the new plant

manager stated he thought R&D and the primary design work would remain in the US. However, he was planning to create a "custom design" group in Reynosa as soon as he could hire the right people.

Two additional examples within our sample also provide interesting clues whether or not third generation firms represent the most competitive maquila segment. At the time of our interview, one plant competing in global markets had a 125 person local design group. Originally owned by a struggling and then bankrupt US company, the maquila had been taken over by an Asian TNC. After experimenting with the Asian parent performing basic design and Reynosa customizing products for the US and Latin American markets, the Reynosa design group was shut down. Finally, there was only one plant in our sample where engineers made up more than eight percent of plant employment (25 engineers out of a total of 125 employees). After the manager who had originally championed this start-up left the company and a parent company audit discovered key policies were not being followed, the plant was shut down.

(c) Guadalajara

As briefly mentioned in Section Three, in Guadalajara we concentrated our data collection efforts on the most prominent lead firms within the local electronics cluster (parent company 2002 revenue averaged $13.9 billion). Recently bought out by a very large TNC, one 30 plus person firm was founded in the mid-1990s-by a group of IBM trained design engineers. At the time of our interview, they were expanding a lab to be used to test prototypes of highly complex electronic components. At a second large TNC where the Guadalajara plant is used to supply the Americas, local employment fell by roughly 400 as the parent shifted production lines from Mexico to the US and England.

For purposes of this study, the most useful interviews took place at our other three sample firms. These companies fit a common profile; they are all electronic contract manufacturers controlled by TNCs with extensive global operations that built plants in Guadalajara in the mid to late 1990s. These three firms all utilize capital intensive, technologically advanced processes to manufacture a variety of increasingly complex products. These plants have established, or are in the process of establishing, secondary design centers. For example, the director of manufacturing at one plant stated they "have a design platform for product testing" as well as perform "design for manufacturability" functions. They also plan to establish a group with product design capabilities in the near future. At another plant our interviewee stated they were "participating, but not leading" in the design process. They recently expanded a lab to improve their product testing capabilities.

The similarities between these three contract manufacturers did not end there. In 2000, these firms collectively employed as many as 28,500 people. By June, 2003, all three firms had significantly reduced headcount and employment had dropped to 17,500. Our interviewees used identical statements to describe how their strategy changed during this time period. With many of the standardized, complex products they produced in the past now being made in China, they shifted from a "low mix, high volume" to a "high mix, low volume" rapid response business model. This shift resulted in significant changes in what was happening on the shop floor. For example, in the recent past one plant had 5,000 part numbers that were used to produce 200 items for 5 primary clients. At the time of our interview, they now had 10,000 part numbers, produced 800 products, and had 15 clients. Similar to other firms in both Guadalajara and Reynosa, our interviewee stated with the increasing product variety they reorganized the production floor into manufacturing cells and purchased more flexible equipment. Interestingly, he stated highly specialized machines designed for standardized production

tend to be more costly than the multi-purpose equipment they were now using. Finally, given their inability to compete in global markets, all three firms are attempting to increase their presence in industries characterized by mixed global/regional or purely regional competition (such as auto parts and medical equipment).

Considering both our Reynosa and Guadalajara samples, in Table Four, we present a summary of our primary findings.

Table Four: *Summary of Findings*

Global Markets - Defined as markets where maquiladoras face direct competition in the US from producers located in lower cost countries. In our sample, with few exceptions low, medium, and high tech firms competing in global markets were struggling. To survive, high tech TNCs in Guadalajara were trying to move as quickly as possible into markets characterized by mixed global/regional and regional competition.

Mixed Global/Regional Markets - Defined as markets where maquiladoras have conceded the production of high volume, standardized, low cost goods sold in the US to producers in lower cost countries. To compete successfully in non-standardized segments, maquiladoras have adopted the following business models:

Corporate shelter - These are plants that provide common support services (HR, IT, import/export, accounting, etc.) and rent out space to multiple parent company divisions. Shelters, and the closely related contract manufacturing approach, allow the divisions to efficiently transfer non-standardized, time dependent, low volume products from higher to lower cost production locations.

Dual sourcing - TNCs in this subcategory utilize factories in the lowest cost EPZ as the high volume production location. Maquiladoras produce the same items but are used to quickly respond to demand fluctuations in North American markets.

Mass customization - These maquiladoras produce made to order, time dependent products to North American customers.

Regional Markets - Defined as markets where maquiladoras do not face direct competition in the US from producers located in lower cost countries. Successful business models in this category include:

JIT producers - These are typically large auto part manufactures. To efficiently produce on a JIT basis, major assemblers in North America often require their suppliers to be located in the region.

Zero defect producers - In industries such as medical products and aviation, 100 percent product quality is a requirement. Moving production to the lowest cost EPZ but where quality may not be as high is a risky and given high margins unnecessary strategy.
Low value to weight producers - For these firms, the costs savings that might come from producing in the lowest cost but geographically distant EPZ are nullified by transportation costs.
Remanufacturing centers - To perform repair work in a lower cost but geographical distant location, items would have to be shipped from the US and back again. Given the transportation costs and time involved, this typically does not represent a viable business model **5.**

DISCUSSION AND CONCLUSIONS

Drawing from the example provided by Mexico's maquiladora industry, in this study we examine the question of what happens in a mature, technologically advanced EPZ when total costs increase. Our study is inherently comparative; the major TNCs in our sample have production locations in a number of industrialized and developing countries. For them to choose to produce in a higher cost EPZ, there clearly must be a compelling reason to do so. In contrast to our own expectations as well as recent studies in the maquila literature, we found the ability to use advanced technology to represent only a partial explanation for why our sample firms remain in Mexico. In fact, some of the most technologically advanced maquilas are among the sample firms most affected by the increase in costs. For example, the contract manufacturers in Guadalajara, all of which produce highly complex products utilizing leading edge manufacturing technologies, suffered very significant job losses. In addition, the sample firm with by far the largest design group ended up consolidating this activity in the parent's home country by the end of the study period.

This study does provide a clear message regarding what firms will stay and what firms will go when total costs increase in an EPZ such as Mexico. In our sample, maquiladoras competing in global markets were failing at an alarming rate while those in mix global/regional and purely regional markets were on average doing very well. Within their industry and the parent company's sourcing network, our

interviewees stated standardized products requiring long production runs will be produced in the lowest cost country (almost always China). As part of the parent company strategy, Mexico is now being used to manufacture or assemble products in industries and/or industry segments where customer demands are such that geographically distant, lower cost countries do not represent a viable production location. Put in slightly different terms and as stated by one plant manager, "The only reason to produce in Mexico is for some reason you have to be here." Fortunately, our interviewees identified several reasons for why firms have to be in Mexico.

As the only major maquila city not experiencing significant job losses during the 2000 to 2003 downturn, Reynosa provides a valuable location in which to examine the characteristics of successful firms in higher cost EPZs. Put simply, in our view the primary reason the Reynosa cluster has been successful is the majority of maquiladoras in the city do not face direct competition from producers in lower cost countries. Collectively, Reynosa's success also appears to be based on fully embracing rather than resisting the new rules of the game. For example, Sargent (2004) found from January, 2000 to September, 2002 17 maquiladoras closed plants in Reynosa. Over the same time period, however, local economic development officials (this group proactively markets Reynosa as a location for mass customization operations) were able to attract 23 new firms to the city. The consistent message we received from our interviewees at firms in the struggling electronics manufacturing cluster in Guadalajara serve to reinforce and extend our Reynosa findings. In the late 1990s when Mexico was more cost competitive, one of our sample firms employed as many as 11,000 people. Faced with rising costs, the production of several high tech, high volume standardized products was relocated to China and by 2001 employment dropped to as low as 4,500. To survive, the Guadalajara plant shifted to a low volume, high mix strategy and worked to gain an increased presence in industries characterized by mixed

global/regional and regional competition. With a more appropriate business strategy, employment increased to 6,000 by late 2003.

For developing countries with EPZ programs, we believe this study has a number of important implications. The Mexican experience suggests more positive development outcomes (specifically higher wages for lower level employees and the ability to increase taxes on participating firms) does not automatically result once the dominate production model in a zone transitions from low tech assembly to more complex products and processes. The responses we received from our interviewees regarding the factors determining parent company sourcing strategies supports the view that major TNCs have the capacity and the motivation to transfer the production of standardized products (in low, medium, and high tech sectors) to the lowest cost location they can find. To sustain a higher cost structure, developing countries need to offer exporters a convincing economic rationale for why they should locate in their country. Geographical proximity is clearly at the heart of the viable higher cost EPZ business models identified in this study. Similar to Mexico, other low income countries located close to rich, industrialized areas (such as those in Eastern Europe) may be able to leverage their geographical advantage and end up with rising wage rates while retaining a dynamic EPZ sector. Unless they have some other rare competitive advantage, however, geographically isolated countries with EPZ programs may be forever relegated to competing for the production of standardized products through offering TNCs low wages and investment incentives. Given the limited potential of this development model, these countries may want to invest their scarce development funds in other, more worthwhile initiatives.

Our study also has interesting implications for the economic relationship between developing and industrialized countries in general and the US and Mexico in particular. Vernon's (1966) international product life cycle states newly introduced, innovate products will be manufactured in

industrialized countries while the production of mature, standardized, commodity type goods with a significant labor component will be farmed out to the developing world. For the most part, the product life cycle provides a reasonably accurate characterization of the types of manufacturing activities relocated to Mexico during the first 30 years or so of the maquiladora program. However, with standardized products now being lost to lower cost areas, maquiladoras are increasingly competing head to head with manufacturers located in the US for the production of non-standardized goods. As the forces of globalization increasingly place the jobs of highly skilled, well paid US employees in both manufacturing and services at risk, these groups may join with others (such as labor unions and non-governmental organizations) in their opposition to free markets and unrestricted trade.

This study does have a number of limitations. First, our findings are primarily based on qualitative data collected from a large number of firms in Reynosa and Guadalajara. Additional research drawing from other EPZ concentrations in Mexico as well as elsewhere using alternative methodologies are needed in order to validate and extend our findings. The primary generic distinction we made in this study is between higher and lower cost EPZs. More accurately, this study examines how Mexican EPZs are attempting to survive when faced with increased competition in US markets from Chinese producers during the 2000 to 2003 period. Policy makers in other developing areas should carefully consider whether the lessons drawn from these countries and this time period are applicable to their own circumstances. In addition, our analysis has largely assumed free trade exists between countries. This is clearly not an accurate characterization of prevailing market conditions in many parts of the world. In our view, the continued presence in Mexico of producers in segments such as apparel (no duties and quotas for NAFTA producers) and televisions (steep duties on non-NAFTA picture tubes)

provides considerable evidence that at least in the short term preferential market access is an effective way for standardized product EPZ producers in higher cost areas to compete.

To summarize, our examination of Mexico's maquiladora industry suggests upgrading into higher value added, more technologically complex manufacturing is not sufficient to create EPZs capable of supporting a higher cost structure. Given there will always be a developing country somewhere willing to offer TNCs lower wages and attractive incentives, and TNCs have the ability to efficiently transfer the production of complex products to lower cost areas, host countries with mature EPZs should focus on attracting producers of non-standardized goods exporting to markets characterized by mixed global/regional and regional competition. Mexico and the maquiladoras still face considerable adjustment pains and the loss of standardized product producers if the peso remains strong. However, the success of the Reynosa cluster and the emergence of corporate shelters, JIT, zero defect, and low value to weight producers, remanufacturing centers, and firms following dual sourcing and mass customization strategies provides considerable evidence Mexico's EPZ industry can survive and even expand with a higher cost structure. Even considering the job losses experienced over the 2000 to 2003 period, we believe Mexico and the maquiladoras are well positioned to benefit from the opportunities offered by today's global, or perhaps more accurately stated, mixed global/regional and purely regional, economy.

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