Why aren't all the maquilas located in Chiapas?
A re-examination of the low labor cost hypothesis

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The title of the paper is obviously rhetorical, but it asks that we think more clearly about the answer to the question it poses. The growth of Mexico's maquiladora industry is not concentrated in the state with the lowest percapita income where wages are also among the lowest in the nation. Similarly, domestic U.S. manufacturing does not migrate to Mississippi, or EU production to southern Italy or Portugal. The roads are bad, the labor force ill-prepared for industrial work, it is a long ways from markets, power systems are inadequate, and so on. The reason why manufacturing firms do not choose to locate in the place with the lowest possible wages is relatively easy to understand since low wages also signal that firms will run into a number of production obstacles which, taken collectively, may easily outweigh the labor cost savings.

To better understand the implications of this obvious point for the maquiladora industry, it is useful to ask the question of the title in a slightly different way. If firms choose not to locate in Chiapas or other low wage regions because of the production disadvantages, are there regions with particular production advantages that act as magnets to attract firms? Again, the answer is obvious. Perhaps a better title for the paper might be "Why do so many maquiladoras locate on the U.S.-Mexico border?"

This paper proceeds as follows. The next section reviews the growth record of the maquiladora industry. In light of numerous obstacles to growth, the remarkable growth record raises a few questions about the conventional view that growth is based solely on labor costs. Recent obstacles to growth are described in the second section, and followed in the third by a discussion of two nonexclusive theories of location decisions and trade. The first is the theory of comparative advantage, while the second relies on the idea of scale economies to explain regional concentrations. After a description of these theories, the regional concentration of employment in Mexican manufacturing is

measured with industry-specific Gini coefficients. This is followed by a regression model to test some of the determinants of concentration. The final section returns to a discussion of the maquiladora and attempts to provide some preliminary explanations for its remarkable geographical concentration.

The maquiladora industry growth record

Between the two most recent economic censuses, the growth of the maquiladora industry raised its share of total manufacturing employment from 16.1% in 1993 to 23.9% in 1998 (INEGIa, 2001). Through the decade of the 1990s, employment in the industry grew at an average rate of 11% per year, reaching a total of 1.339 million employees at the end of 2000, and generating over 25 billion in total compensation, measured in 1994 pesos (INEGIa, 2001).[1] In 1999, the industry had a trade surplus of approximately $US12 billion, along with a net foreign direct investment inflow of approximately $US11 billion (CIEMEX-WEFA, 2000; and Christman, 2000). As a result, it contributed around $US23 billion to Mexico's foreign exchange holdings and helped keep the peso strong while avoiding surges in inflation that undermine the purchasing power of wages.[2]

Table 1 splits recent growth in the industry between border states (defined by INEGI to include the five states of Baja California, Sonora, Chihuahua, Coahuila, and Tamaulipas) and the rest of the country. One of the features of recent growth is the southward migration of new and existing firms, but as shown in Table 1, the absolute

[1] The growth rate is calculated as the twelve month moving average of monthly data, based on data from INEGI.

[2]This role is important since inadequate foreign reserves make a country vulnerable to speculative attacks against its currency. While depreciations make exports more competitive, in Mexico a falling peso quickly passes through the economy in the form of higher prices and falling real wages. The net effect is contractionary for the macroeconomy.

number of new jobs created continues to be overwhelmingly a northern, border, phenomena.

[Table 1]

Table 2 examines the growth of employment in the main cities of the border states, as well as a few other locales such as Mexico, DF, and the state of Mexico which also experienced rapid growth. As evidenced in Table 2, employment growth has been extremely rapid in the northern states, and shows no signs of slowing.

One consequence of firm in-migration is that the existing labor force is inadequate to fill the available positions. Economic theory predicts that in order to attract additional workers, firms in the rapidly industrializing border states will be forced to pay higher wages. Hanson (1997) confirmed a regional structure of wages in Mexico, where wages are higher in the capital and the surrounding areas, and along the border. Hanson's estimates show that a 10% increase in the distance from Mexico City resulted in a 1.92% decrease in relative state level nominal wages, while a 10% increase in the distance from the border is associated with a 1.28% decrease in the state relative nominal wage.

[Table 2]

Obstacles to growth

In addition to the higher relative wages of the border states, maquiladora firms also ran into a substantial amount of tax uncertainty during the last several years. In part this stems from Article 301 of the NAFTA which eliminates the duty drawback granted by the Mexican government to maquiladora firms, but it has been compounded by the introduction of Permanent Establishment (PE) clauses in the tax code, and the loss of exemption from antidumping duties.

Tariff uncertainties

Under Article 303 of the NAFTA agreement, duty free imports from non-NAFTA countries ended in January of 2001. The contours of the new tariff regime has been a major industry concern over the last few years (Gerber, 1999). In 1999, after several false starts, Mexico's Commerce Department (SECOFI) announced that it would develop sectoral programs (PROSEC) to protect the tariff free entry of maquiladora imports from non-NAFTA countries. PROSEC allows qualified applicants—both maquila and non-maquila—to apply for reduced tariffs of 0-5%, and covers most of the products coming into the maquiladora industry, including, electronics, electrical equipment, chemicals, textiles, autos, and others. SECOFI was slow to define the process for applying to the sectoral programs, and was exceedingly slow to specify the tariffs. After years of trying, SECOFI came up with a plan that was unworkable, resulting in its suspension at the start of 2001. In short, firms continue to lack clear information about the new tariff regime.

New income and asset taxes

A second, much more complicated tax issue concerns the income and asset taxes facing the industry. In 1998, the Mexican government announced that as of January, 2000, the U.S. parent company of Mexican maquilas will be treated as though they have permanent establishment (PE) in Mexico. This ruling requires them to pay Mexican income taxes on the share of their income derived in Mexico, plus a 1.8% asset tax on their machinery, equipment, and inventories. The National Association of Maquila Manufacturers (CNIME) opposed the PE rules, pointing to the significant uncertainty about the share of their income they derive from a Mexican operation. In addition, they objected to the absence of tax credits in the U.S. which creates double taxation. That is, under the proposed rules, firms pay taxes on income derived from their Mexican operation, and then face a tax liability for the same income in the United States.

In response to the double taxation issue, the Mexican internal revenue agency (SAT) and the U.S. Internal Revenue Service (IRS) worked out a Safe Harbor agreement, allowing firms to avoid the PE designation by electing to pay a 6.9% tax on assets *employed* in Mexico, or a 6.5% tax on the cost of the maquila operation, whichever is greater. If profits are less than either of these two amounts, they have the option of signing an Advanced Pricing Agreement (APA) which covers the methodology used to calculate costs of production and the value of assets.

Based on anecdotal evidence, representatives of the maquiladora industry dislike all these options. First, the PE rules create double taxation. Second, the Safe Harbor and APA rules are set to expire in 2002, when the OECD will release a set of guidelines for taxing foreign based multinationals. The coming expiration of the Safe Harbor and APA provisions make them short run solutions, rather than long run, and denies the industry a clear picture of its future tax situation. Third,, the government has been slow to approve the Advanced Pricing Agreements that firms have already begun to use. When a firm elects to use the APA method, it submits a proposal to the government for evaluating its costs of operation and asset values, but there is a long lag between the submission of a proposal and a response from the government. Consequently, some firms are still uncertain about their tax liability for previous year's production.

Antidumping duties

Another uncertainty is the loss of the industry's exemption from antidumping duties (ADD). These are compensating tariffs on imports, levied when an import sells below "fair market value" and a determination is made that the low price has hurt a domestic producer. There are a number of current maquiladora industry imports,

particularly goods coming from China, that have ADDs imposed on them. Prior to January, 2001, the maquiladora industry was exempt from these duties.

Two views of location and growth

Apparently, uncertainty about future taxes, higher labor costs, higher tax liability, and the growing congestion effects in the northern border region,[3] have not stopped growth. There are several possible reasons for this, not the least of which might be an increase in the lobbying skill of the maquiladora industry. Industry leaders may be uncertain about the final shape of tax policy, but they seem relatively confident that it will not be detrimental to the industry's future growth prospects. While the Finance Ministry (SHCP) and the Commerce Department (SECOFI) struggle to determine whether the tax revenue or economic development goals will dominate, the importance of the industry to Mexico's employment, trade balance, and foreign investment inflows, seem likely to guarantee reasonable compromises on the tax issues.

A second reason for continued growth is that the underlying conditions are strong enough to overcome the worries about future tax liabilities, rising wages, greater environmental enforcement, and other potential cost factors. This point is worth emphasizing because it signals that it may be erroneous to think of the maquiladora industry as an assembly industry based on low wages. If the growth inducing factors in the industry are a result of something other than low wages, then it may be wrong to assume that the industry's development is solely based on Mexico's comparative advantage in labor intensive industries.

The assumption that low wages are the main determinant of industry location decisions immediately runs into three problems. First, it cannot explain the location

[3] Water shortages and developing power shortages are among the most notable.

decisions of firms given the regional structure of wages inside Mexico, nor does it do well with the fact that wages in the maquiladora have steadily recovered the value they lost after the peso collapsed in late 1994 and 1995.[4] Second, the comparative advantage model is unable to explain the geographical concentration of several key sectors, including electronics, and cars and car parts. And third, firms that base their production decisions on the availability of low wage labor are very sensitive to changes in their overall cost structure, not just labor costs, and yet strong growth has continued in spite of the industry's uncertainty about future costs and the likelihood that whatever the result on the tax front, taxes will take a larger share of future revenues.

During the last 15-20 years, trade economists have developed a number of alternative models of trade and growth. These models do not rule out a role for comparative advantage, but certain types of trade are clearly not well explained by traditional models of the Heckscher-Ohlin, factor proportions, variety. One of the more prominent models of the last decade and a half is the idea of economies of scale (EOS) based trade. EOS is the simple idea that the average cost of production declines as a firm increases its size, at least up to a point. EOS limits the number of plants a firm can build, since each one must be of a minimum size. In addition, transportation costs play an important role, since they provide strong incentives to locate production as close to the market as possible.

The industrial development of northern Mexico is a clear illustration of the effects of EOS based trade. Prior to 1986 or 1987, when Mexican economic policy favored the

[4]Between January, 1996, and October, 2000, real average maquila wages for all classifications of workers rose at the average rate of 4.13 pesos per month, in 1994 peso values. The increases varied by job category, with higher level workers earning bigger increases. Schmaedick (2000) describes the occupational variability in maquila wage increases in one border community. The estimated average

production of import substitutes rather than exports, there were strong incentives for firms to locate in or near Mexico City. Since production incentives were oriented towards the domestic market, high transportation costs and the need to produce in only a few locations dictated that Mexico City was the logical location. After the opening of the Mexico's economy, however, the implicit incentives economic policy began to favor production for external markets. In Mexico's case, the largest external market is the United States, and the northern border states are as close as possible to that market. Therefore, in order to reduce transportation costs, and given that production of a particular type must be confined to a few plants, the optimal location strategy is to place the plants in as few locations as possible, each of which should be physically close to the U.S. market (Krugman and Livas Elizondo, 1995).

This type of scale economy is called internal economies of scale, since the scale effects are generated inside the firm. A second form of scale economies occurs when there is no incentive for individual firms to get larger, but each firm becomes more productive as the industry grows. In this case, the scale economies are external to the firm, but internal to the industry. External economies stem from the ability of firms to share a common labor pool, a common supplier base including nontraded inputs (legal, accounting, marketing, etc.), and information about markets and trends (Marshall, 1920).

Figure 1 illustrates the key ideas of these two types of scale economies. Note that there is an undefined amount of overlap between the two, and that some firms may have both types. Note also that while it is relatively easy to identify the factors that determine internal economies of scale (high fixed costs plus significant transportation costs) it is

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monthly increase in wages at the national level is based on the author's calculations using data from INEGI, *Banco de Información Económico.*

much harder to identify those that lead to external economies and regional agglomerations. Historical accident may play an important role (e.g., the role of World War II in the development of Monterrey, as well as its role in the creation of a commercial jet aircraft industry on the West Coast of the United States) and give the regional concentration of firms an unexplainable, accidental, component. Once established, however, external economies generate significant self-reinforcing factors that lead to more and more growth. Eventually the centripetal forces of growth inducement are offset by the centrifugal forces of congestion, including wage increases and other costs.

Quantitative measures of regional concentration

Regional agglomeration, or geographical concentration, plays a significant role in the determination of the location of manufacturing industries. Before showing this for the maquiladora industry, it is first necessary to turn to Mexican manufacturing in general, including both maquiladora and non-maquiladora firms. This is necessitated by the relative paucity of maquiladora data at the subsector and branch level, and by the fact that the Economic Censuses of Mexico do not differentiate between maquiladora and non-maquiladora establishments. After a brief analysis of geographical concentration in Mexican manufacturing, the paper returns in the next section to the maquiladora sector.

Table 3 illustrates the relative concentration of Mexican manufacturing. The measure of geographical concentration for the major economic activities is the Gini coefficient, which is calculated with a modified Lorenz Curve with percent of GDP on the vertical axis and percent of each type of economic activity on the horizontal. Figure 2 illustrates the idea of a Gini coefficient used in this way. The unit of observation for economic activity in this and subsequent tables is the state.

[Table 3 and Figure 2]

The top half of Table 3 shows the concentration indexes for non-manufacturing sectors, and the bottom half shows nine major manufacturing subsectors. A number close to zero indicates that the activity is spread across the states in proportion to each state's share of national GDP, while a number close to one indicates a highly concentrated industry. It is not surprising that economic activities such as commerce, services, and construction are spread relatively evenly, while the resource dependent non-manufacturing industries are relatively concentrated. Similarly, the least concentrated manufacturing industry is food processing, much of which is performed locally and is the one manufacturing sector in which nearly all states have significant activity.

The data in Table 3 are at a high level of aggregation but they are useful for making the point that internal and external scale economies play a much larger role in manufacturing than in most other, non-resource dependent, economic activities. Table 4 shows the analysis carried one step farther. State level manufacturing data is disaggregated to the branch level (54 branches in all), and employment rather than GDP shares are used.

[Table 4]

The indexes in Table 4 show a wide degree of variation, from boilers and metal structures (branch 3812), furniture making (branch 3320), and dairy products (branch 3112) at the low end, to basic petrochemicals (branch 3511), petroleum refining (branch 8291) and tobacco products (3140), at the high end. Again the pattern is that resource dependent industries are relatively more concentrated, and those that utilize inputs that are widely available or produce foodstuffs for the local economy are relatively evenly spread.

In order to test whether the industry characteristics are consistent with the patterns of geographical concentration, and to shed some light on the relative importance of scale economies in Mexican manufacturing in general and the maquiladora industry in particular, a simple regression model is specified. In particular, the Gini coefficients for the 54 industries in Table 4 are regressed on three variables that measure various components of alternative trade theories.[5]

The Heckscher-Ohlin theory of comparative advantage predicts that industries with high capital requirements will locate where capital is relatively abundant, and industries with high labor requirements will locate where labor is relatively abundant. In the context of a location decision for firms within a single country and where labor and capital are completely mobile, the concepts of relative scarcity and relative abundance are somewhat attenuated. Nevertheless, regions do vary in their ability to offer public infrastructure such as ports, highways, and so forth, as well as in their offering of labor. In particular, high labor demands can be better met in a major metropolitan area, or in a region noted for its ability to attract large flows of interstate migration.[6]

This idea is captured with a proxy for factor intensity:

$$FACTORS_i = |(w_iL_i/VA_i) - Mean(w_iL_i/VA_i)|,$$

where w_iL_i is the wage times the labor force in industry i, or total ith industry wage payments, and VA_i is value added by the ith industry. $FACTORS_i$ is calculated as the absolute value of the deviation from the mean. High values for $FACTORS_i$ imply a relatively labor intensive industry, while low values imply a capital intensive industry.

The second variable captures the effect of scale economies at the firm level:

$$SCALE_i = employment_i/firms_i,$$

[5] This model was first used by Amiti,1999.

Where employment_i and firms_i are measures of total employment and the number of firms in the ith industry. SCALE_i measures the overlap between internal and external economies of scale. That is, there is no reason *apriori* why larger firms should concentrate geographically near other firms in the same industry. If, however, external economies are also present, then we should expect to see a strong pattern of association between SCALE_i and the dependent variable, GINI_i.

Finally, the third variable captures the upstream and downstream effects of the demand linkages and cost linkages that have been emphasized in recent works of economic geography (Krugman and Venables, 1995). This work analyzes the causal factors behind the geographical concentration of industries, and has shown that an abundance of firms in one industry will attract a large number of suppliers to the industry (demand linkage), which creates a positive feedback effect (cost linkage) through competition among suppliers. This creates an incentive for users of the intermediate goods to locate nearby and adds to the regional concentration. These impacts imply that industries that require a high proportion of intermediate inputs are more likely to concentrate geographically. This effect is proxied with

$$\text{INTERMEDIATES}_i = (\text{Intermediate inputs})_i/(\text{Total output})_i.$$

Table 5 shows the mean values for the dependent variable and each of the three independent variables, and Table 6 shows the results of least squares estimation. The results in Table 6 show that both factor intensity and scale effects play a significant role in the geographical concentration of firms, while intensity in the use of intermediate inputs is insignificant. Both the factor intensity variable and the scale variable have moderate effects, with a 10% increase (or decrease) in the former leading to

[6] Mendoza, 2001, finds a link between metropolitan population and industrial concentration.

approximately a 0.8% increase in the Gini coefficient. The scale effect is about one-half the relative size of the factor intensity effect, with a 10% increase in scale associated with a 0.4% increase in the Gini coefficient.

[Tables 5 and 6]

Maquiladora industry comparisons

The regression analysis and the data in Tables 4 and 5 include both maquila and non-maquila firms. Table 7, which separates out the maquiladora industry by subsector, shows the SCALE and FACTORS[7] variables. One major difference characterizes the maquiladora industry, namely the much larger average firm size. Taken as a whole, maquiladora firms are 85% larger than the average of the 54 branches (and 2,108% percent larger than the average Mexican firm which has 12 workers). Furthermore, since 1993, there has been a significant increase in average firm size in most but not all subsectors of the maquiladora industry. This is a trend that has not been followed in the rest of Mexican manufacturing, as the 1999 Economic Census reports approximately the same size firm as in 1993 (INEGIc, 1999).

[Table 7]

Table 7 also shows that the share of wages in maquiladora industry's total value added is roughly the same as the average for all 54 branches of Mexican manufacturing, although once again, there has been a consistent pattern of change over time. Only one of the 12 subsectors reports an increase in the wage share, with the other 11 all registering increases.

The implications of the regression analysis and the data in Table 7 are that maquiladora firms are more concentrated than average Mexican manufacturing, in part

because they are larger, and to a smaller degree depending on the subsector, because their factor intensities are more extreme.

The regression results and Table 7 do not establish a causal link from scale to geographic concentration but it is useful to speculate about the connection. Given that internal scale economies with significant transportation costs dictate that firms should locate in as few places and as close to the market as possible, it is not surprising to see the maquiladora in the northern border region, near the U.S. land-based and water-based ports. What is perhaps less obvious is that the scale effects also imply a high demand for labor and other inputs and that these may also be a source of geographic concentration and economic advantage.

The regression model does not distinguish between these two sources of advantage in regional concentration--location near the border and the availability of labor and other inputs--but consider what the elements of the second source might be. About one-half of the (Mexican) value added in the maquiladora industry is direct labor and about one-half is a combination of indirect labor, services, intermediate goods produced in Mexico, and miscellaneous other inputs. As shown in Table 8 when value added in the maquiladora industry is decomposed, a number of additional elements appear.

[Table 8]

Two observations are relevant here. First, machinery rental and repair, provision and maintenance of telecommunications equipment, shipping and handling, and others, constitute specific services that easily incorporate a learning by doing component. Second, in a number of cases, the direct labor component also contains significant job skills. About 20% of industry employees are technicians or administrators, while even

[7] Note that Factor Intensity in Table 7 is simply ($w_i L_i / VA_i$) rather than absolute value of the mean deviation

some assembly workers are required to have job skills associated with a level of training or work experience beyond that necessary to perform simple repetitive tasks.

A recent analysis of maquiladora firms in Tijuana's burgeoning medical equipment industry illustrates this point. Table 9 shows the knowledge and comprehension elements, along with the abilities and attitudes expected of an assembly worker. While primary education may suffice, secondary is preferred.

[Table 9]

This point should not be misunderstood. Assembly work is not skilled work, although it may demand a level of attention and initiative that is often underestimated. Rather the point is that firms with high demands for large numbers of assembly workers will not be able to fulfill their labor needs anywhere. Location in an environment where there is an existing pool of experienced assembly workers has several advantages since workers know what to expect and require less training. At the same time, workers outside the region know that jobs are plentiful and provide a powerful inflow of new labor to the region. And supporting services such as equipment maintenance are easier to procure.

Conclusion

Growth in the size of firms, growth in the number located near the U.S. market, growth in the number of firms devoted to related lines of production, and intensification of the geographical concentration of products, are indicative of an industry that benefits from both internal and external economies of scale. All these elements are to a degree self-reinforcing, and as they develop, the industry becomes more rooted in the region.

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used in the regression.

This view of Mexico's northern border assembly industry is not entirely at odds with the traditional, cheap labor, explanation for industrial location. Some types of production, apparel for example, are far more sensitive to wage costs that other types. The focus on wages, however, and the assumption that they are the main cause of the industry's performance, has overlooked some additional reasons for the industry's growth. In particular, the industry's location close to the U.S. market where transportation costs are minimized, and the growing concentration of production in a relatively few manufacturing sectors, indicates that factors other than wages are fostering growth. The point is not that wages do not matter. They clearly matter, both to firms and to workers. Rather, the point is that the industry's growth may be more robust than is generally appreciated, and that wage increases are not as detrimental to the industry's future as many people assume.

One important difference between the economies of scale explanation of maquiladora industry growth and the comparative advantage explanation, is that the former emphasizes the problems of urban congestion. Regional infrastructure such as roads, water, energy, telecommunications, housing, schools, and health care, are stretched beyond existing capacity. Yet, according to the EOS explanation, the maquiladora industry will continue to concentrate growth in the northern tier of border states until the congestion effects begin to choke off new growth. It is impossible to predict when or even if this will happen (consider, for example, housing prices in Silicon Valley). Accordingly, if there is a policy implication of this view, it is that there will be increasing pressure to meet the needs for additional regional infrastructure, including trade infrastructure, but also schools, housing, hospitals, and other facilities for meeting human needs.

Sources

Amiti, Mary, "Specialization Patterns in Europe," *Weltwirtschaftliches Archiv.* 135:4. pp. 573-593. 1999.

Balcazar, María Luisa, "Competencias laborales y capacitación en la industria de productos médicos," Working paper, Instituto Technológico de Tijuana.

CIEMEX-WEFA, *Maquiladora Industry Outlook,* 13:3. September 29, 2000.

Christman, John, "The maquiladora Industry Outlook, 2000-2005," in CIEMEX-WEFA, *Maquiladora Industry Outlook,* 13:3 September 29, 2000.

Gerber, James, "Perspectivas de la Maquiladora después del 2001." *Commercio Exterior*. 49:9. September, 1999.

Hanson, Gordon, "Increasing Returns, Trade and the Regional Structure of Wages," *The Economic Journal.* 107. pp. 113-133. 1997.

INEGIa, *Banco de Información Económica.* Industria Maquiladora De Exportación, Indicadores Mensuales. Available online: http://www.inegi.gob.mx. January, 2001.

INEGIb, *Censos Economicos 1994, Resultados Oportunos: Tablados Basicos*. Aguascalientes, Mexico. 1994.

INEGIc, *Censos Economicos 1999.* Available online: http://www.inegi.gob.mx. January, 2001.

INEGId, *Industria Maquiladora de Exportacion.* Aguascalientes, Mexico. November, 2000.

Krugman, Paul, and Raul Livas Elizondo, "Trade Policy and the Third World Metropolis, *Journal of Development Economics.* 49. pp. 137-150. 1995.

Krugman, Paul, and Anthony Venables, "Globalization and the Inequality of Nations," *Quarterly Journal of Economics.* 110:4. pp. 857-880. 1995.

Marshall, Alfred, *Principles of Economics*. London: Macmillian and Co. 1920.

Mendoza Cota, Jorge Eduardo, "Agglomeration economies and urban manufacturing growth in the northern border cities of Mexico." Paper presented to the Association of Borderland Studies. Reno: April, 2001.

Schmaedick, G.L., "Compensation, Inflation and Purchasing Power in the Mexican Maquiladora Industry since the Devaluation of 1994," San Diego Dialogue, Working Paper Series. 2000.

Vargas Leyva, María Ruth, “Grupo ocupacional en la industria de productos médicos: el caso de Medtronic,” Working paper, Instituto Tecnológico de Tijuana.

Table 1
Maquiladora industry employment growth:
Border and non-border,
January, 1999 to January 2001

	Employment, 1/99	*Employment, 1/01*	*Percent change*	*Absolute change*
Border states	829,890	999,172	20	169,282
Other states	230,327	294,462	28	64,135
Total	1,060,217	1,310,171	23	233,417

Source: INEGIa.

Table 2
Average Annual Employment Growth
in the maquiladora industry, 1980-2000:7

	1980-1993	*1994-1998*	*1999-2000:7*
Baja California			
Mexicali	11.2	19.1	10.3
Tecate		12.6	10.8
Tijuana	15.8	13.7	12.8
Sonora			
Agua Prieta		9.0	-14.3
Nogales	3.9	11.8	7.6
Chihuahua			
Ciudad Juárez	10.4	9.5	8.0
Chihuahua	20.6	7.0	13.1
Coahuila			
Ciudad Acuña		11.5	3.5
Piedras Negras		10.6	2.2
Torreón		25.6	13.6
Nuevo León			
Guadalupe		13.5	18.1
Monterrey		23.5	31.9
Tamaulipas			
Ciudad Reynosa		9.4	16.6
Matamoros	7.7	8.1	8.2
Nuevo Laredo		5.4	5.9
Estado de México y Distrito Federal		31.1	22.9
Guadalajara, Jalisco		13.1	7.0

Source: INEGIa.

Figure 1
Internal and external economies of scale

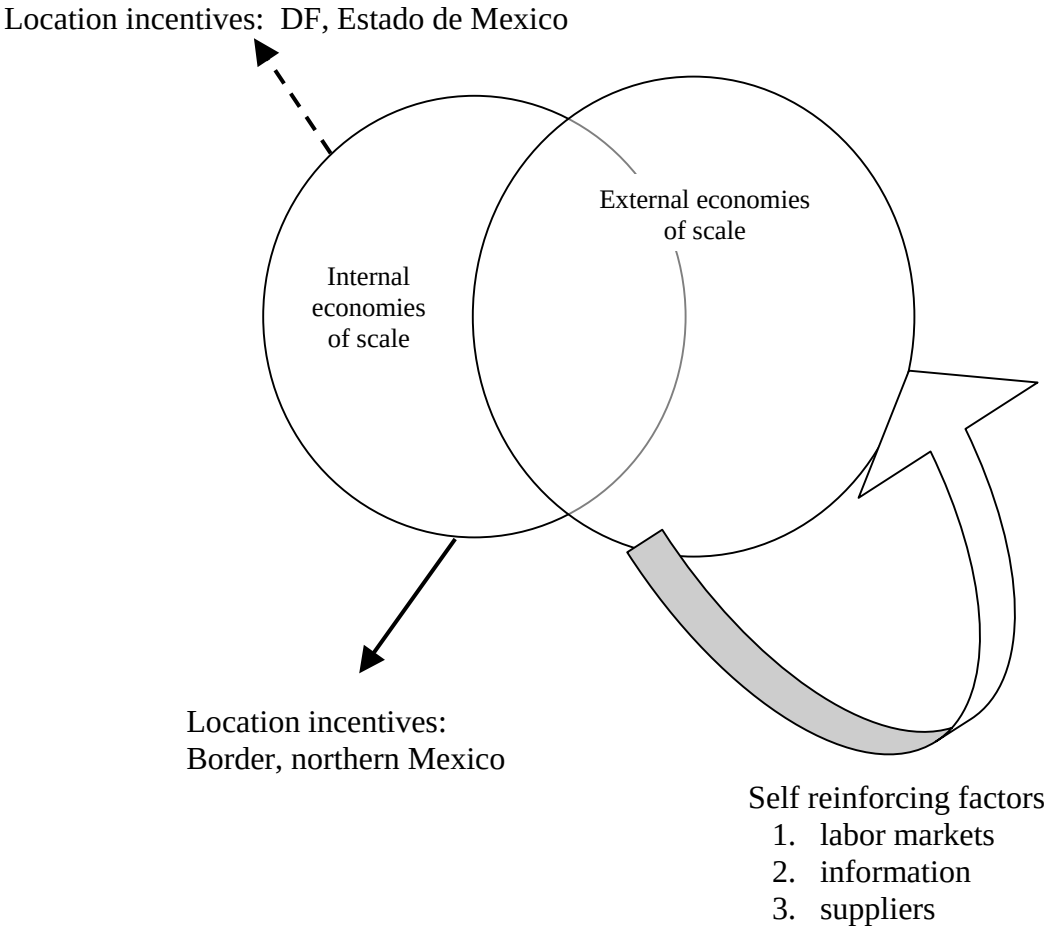

Figure 2
The Gini Coefficient,
Area A/(A+B)

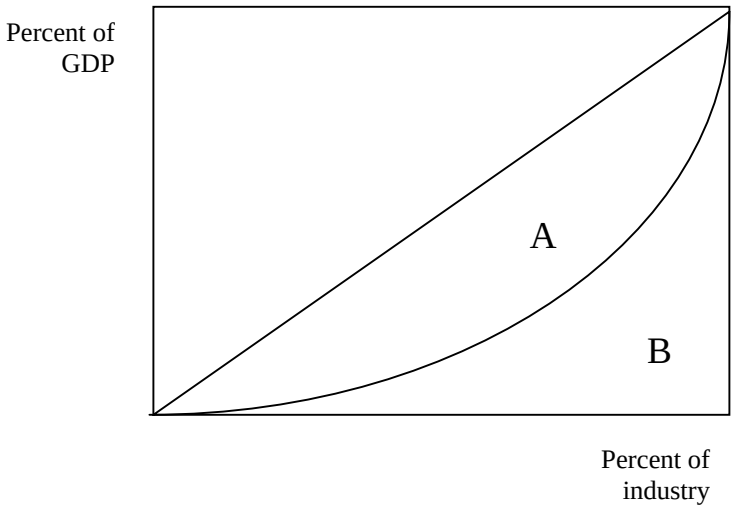

Table 3
Concentration indexes for major divisions:
GDP method, 1993

Sector	*Index*
Nonmanufacturing	
Transportation and storage	0.094
Services, private	0.100
Commerce	0.102
Services, public	0.149
Construction	0.151
Electricity, gas, and water	0.451
Forestry, fishing, agriculture	0.497
Mining	0.758
Manufacturing	
Food processing	0.209
Paper and paper products	0.345
Chemical products	0.367
Textiles and apparel	0.386
Machinery	0.390
Other manufacturing	0.394
Wood and wood products	0.396
Stone, clay, and glass	0.430
Basic metals	0.604

Source: Author's calculations based on data from INEGIa.

Table 4
Concentration indexes, Manufacturing branches, 1993

Subsector and Branch	*Description*	*Concentration index*
Subsector 31	Food, beverages and tobacco	
3111	Meat processing	0.3013
3112	Dairy products	0.2676
3113	Prepared foods except meat and dairy	0.6097
3114	Grains and cereals	0.3429
3115	Bread and baked goods	0.2490
3116	Nixtamal and tortillas	0.3784
3117	Edible oils and fats	0.5082
3118	Sugar and sweeteners	0.8453
3119	Chocolate and candy	0.5561
3121	Other foods for human consumption	0.2770
3122	Animal feed	0.4514
3130	Beverages	0.2599
3140	Tobacco	0.8328
Subsector 32	Textiles, apparel and leather	
3211	Textiles from hard fibers and cordage	0.7699
3212	Thread from soft fibers	0.5482
3213	Carpets and rugs	0.5603
3214	Knitted fabrics	0.4550
3220	Clothing	0.3370
3230	Leather and leather goods	0.5272
3240	Shoemaking	0.7377
Subsector 33	Wood, wood products, including furniture	
3311	Sawmills and lumber	0.5754
3312	Boxes and other wood products	0.5391
3320	Furniture making and repair	0.2529
Subsector 34	Paper and paper products, including books	
3410	Cellulose and paper	0.3074
3420	Printing and publishing	0.3502
Subsector 35	Chemicals, petroleum products, rubber and plastic	
3511	Basic petrochemicals	0.9342
3512	Basic chemicals, except petrochemicals	0.4251
3513	Artificial fibers	0.7091
3521	Pharmaceuticals	0.6620

Table 4, Continued

3522	Other chemicals	0.5175
3530	Petroleum refining	0.8291
3540	Coke and other coal products	0.4400
3550	Rubber	0.4392
3560	Plastics	0.3449
Subsector 36	Nonmetallic minerals	
3611	Pottery and ceramics	0.6262
3612	Clay products for construction	0.4956
3620	Glass and glass products	0.5506
3691	Cement, lime, and chalk	0.2999
Subsector 37	Basic metals	
3710	Iron and steel	0.6322
3720	Other metals	0.6142
Subsector 38	Metal products, machinery and equipment	
3811	Casting and molding	0.4245
3812	Boilers, metal structures	0.2227
3813	Manufacture of metal furniture	0.3781
3814	Other metal products, excluding machinery	0.3494
3821	Special purpose machinery, including agriculture	0.3130
3822	General use machinery, including armaments	0.2729
3823	Office machinery	0.5734
3831	Electrical machinery, including power generation	0.5684
3832	Electronic machinery, including televisions, medical equipment	0.6797
3833	Domestic appliances, except electronic	0.4860
3841	Automotive sector	0.4246
3842	Transportation equipment, except cars and trucks	0.4842
3850	Precision instruments, including surgical	0.6090
Subsector 39	Other manufacturing industries	
3900	Other manufacturing industries	0.3874

Source: Author's calculations based on data from INEGIb.

Table 5
Mean values of regression variables

Variable	*Mean value, 1993*
Concentration index Gini	0.49135
Scale	142.7*
Factors	0.1846
Intermediates	0.68812

*The mean value for scale is 82.0 if petroleum refining (Branch 3530) is excluded.
Data source: see previous table.

Table 6
Regression analysis: Determinants of manufacturing concentration

LS // Dependent Variable is GINI
Included observations: 54

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
CONSTANT	0.511443	0.137268	3.725882	0.0005
FACTORS	0.228724	0.120378	1.900050	0.0632
SCALE	0.000144	4.61E-05	3.127427	0.0029
INTERMEDIATES	-0.120485	0.198366	-0.607388	0.5463

R-squared	0.261330	Mean dependent var	0.491352
Adjusted R-squared	0.217010	S.D. dependent var	0.174411
S.E. of regression	0.154330	Akaike info criterion	-3.666136
Sum squared resid	1.190889	Schwarz criterion	-3.518803
Log likelihood	26.36298	F-statistic	5.896420
Durbin-Watson stat	1.617273	Prob(F-statistic)	0.001584

Table 7
Maquiladora comparisons, by sector

	Scale: *Employees/firms*	*Factor intensity:* *Wages/Value added*	*Employment share:* *Sector emp/Total maq. emp.*
All manufacturing, 1993			
Weighted*	143	0.572	na
Unweighted	12	0.461	
All maquiladora industries			
1993	265	0.556	1.00
1999	346	0.495	1.00
Maquiladora Subsectors			
Food processing			
1993	194	0.300	
1999	145	0.232	0.010
Textiles and apparel			
1993	163	0.577	
1996	256	0.429	0.219
Shoes and leather			
1993	123	0.545	
1999	154	0.524	0.008
Furniture and related			
1993	112	0.502	
1994	149	0.392	0.048
Chemical products			
1993	96	0.463	
1999	154	0.396	0.020
Transportation equipment and related			
1993	749	0.545	
1999	928	0.579	0.183
Equipment other than electrical			
1993	118	0.545	
1999	291	0.502	0.010
Electrical and electronic equipment and related			
1993	504	0.622	
1999	646	0.520	0.082

Table 7, continued

Electrical and electronic materials and accessories			
1993	320	0.580	
1999	572	0.510	0.257
Toys and sporting goods			
1993	238	0.553	
1999	224	0.518	0.012
Other manufacturing			
1993	188	0.539	
1999	268	0.511	0.113
Services			
1993	254	0.630	
1999	215	0.458	0.386

*Average of all branches.
Data source: INEGId.

Table 8
Decomposition of value added, maquiladora industry, 1999

Value added components of total output	*Percent of total output:*		
	Mexico	*Border*	*Non-border*
Material inputs and packaging	2.5	1.2	8.4
Diverse expenditures (Gastos diversos)	6.9	6.0	11.1
Rental of machinery, equipment buildings and land; electricity; telecommunications; customs services; shipping and handling; maintenance; fuel and lubricants; water; other.			
Other	3.1	2.6	5.2
Catering, transport for workers, uniforms, and others.			
Labor	12.4	12.4	12.7
Total	24.9	22.2	37.4

Source: INEGId.

Table 9
Assembly operations: Medical equipment

Capabilities	*Components*
Knowledge areas	Basic technical vocabulary Familiarity with components Methods, specifications for assembly Comprehension of assembly codes and symbols Ability to read a diagram
Comprehension	Oral and written instructions Assembly sequence Procedures and methods
Abilities	Recognize problems Interpret instructions Locate information in a diagram Communicate orally and in writing Use tools Technique of assembly
Attitudes	Attention to instructions Information sharing Constant visual inspection Work in teams

Sources: Vargas Leyva, 2001; Balcazar, 2001.